Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey

Prepared for

Reichhold, Inc.

August 2008

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Philadelphia, PA 19103

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Executive Summary

This report summarizes some of the local and regional environmental impacts from the U.S. Metals Refining Company (USMR) site operations in Carteret, New Jersey, on areas in and surrounding the former Reichhold, Inc., (Reichhold) site in Carteret, New Jersey, as well as in Staten Island, New York. Documentary support for statements made in this report are referenced and provided after the statement, within the body of the report. At one time, the USMR facility covered an area of more than 200 acres along the Arthur Kill at what is known as Tufts Point in Carteret, of which the former Reichhold site (over 45 acres) was once a part. USMR constructed and operated a metals refinery operation that included smelting at 400 Middlesex Avenue in Carteret, New Jersey for more than 80 years (1901-1986). These operations negatively affected the local and regional environment through discharge and disposal of wastes that included direct land disposal of metal slag materials on the former Reichhold site and elsewhere, historical fill, metals deposition from air emissions, and discharges of wastewater and stormwater to the Arthur Kill.

Reichhold acquired its former site in Carteret from USMR as two parcels of real property, on July 27, 1960. The parcel of land south of the former railroad was known as the BTL parcel, while the parcel of land north of the BTL parcel was known as the Staflex parcel. Reichhold managed these two parcels of land as one contiguous parcel of land. Irrespective of Reichhold's obligations under the Industrial Site Recovery Act (ISRA) (formerly ECRA), Reichhold bears no responsibility for causing metals impacts in environmental media, since the use of metals was not a significant part of operations at the former Reichhold site. The overwhelming source of metals on and near the former Reichhold site is from USMR's operations; the discharges of metals from the USMR property took place for several decades prior to and during Reichhold ownership of the site. A review of the site environmental assessment reports, remediation report submittals, and other correspondence submitted by USMR to the New Jersey Department of Environmental Protection (NJDEP) indicated that USMR did not disclose the full extent of its historic operations including the lead smelter plant facility. The existence of a USMR lead smelter plant, which operated for over 20 years, and was formerly located on the Reichhold site, was not acknowledged by USMR until forced to do so through litigation. This plant operated on a previously undisclosed portion of the former USMR facility property, which was more than 45 acres in size.

Photographs of the southwestern portion of the USMR property, taken from the southeast portion of the former Reichhold site in May 2007 and other photographs around the USMR property taken from April through June 2008, indicate that slag materials originating from the USMR operations continue to be exposed at the surface, in soils and sediments. USMR operations also discharged lead and other chemicals including dioxin near the USMR site, resulting in widespread local and regional environmental impacts. Discharges occurred via various media and pathways, including air, storm water runoff, outfalls, groundwater impacts, and the direct disposal of slag and fill in the surrounding low-lying (marsh) areas and upland areas.

Reichhold's primary operations at its former site included manufacture of phenolic resins, molding compounds, specialty esters, plasticizers, and polyester resins. Phenolic resins were manufactured by the condensation of phenols with resins, in the presence of catalysts and minor additives. Molding compounds were manufactured by blending phenolic and/or polyester resins with cellulosic and mineral fillers, initiators, inhibitors, and minor additives. The specialty esters unit produced esters, plasticizers, and polyesters by the reaction of various acids and anhydrides with alcohols and glycols, in the presence of catalysts and minor additives. Metals were not used extensively in Reichhold's operations; the metals used as part of Reichhold's operations were limited primarily to zinc stearate (used in blending the molding compounds) and zinc acetate (additive to phenolic resin). Zinc from Reichholds's operations has not been deemed a contaminant of concern at the former Reichhold and USMR site.

The environmental impacts from the USMR plant operations are so significant that in December 1986 the Environmental Research Foundation reported that **"The [USMR] plant exceeds ambient air standards for lead even when not in operation because large quantities of lead have settled on the ground"**.

The USMR smelter emitted particles and gases into the atmosphere from five separate operations areas and produced localized metals contamination from ground spills and dumping. The operations consisted of:

1. Smelting, converting, and refining
2. Reverberatory furnace refining and casting
3. Precious metals refining
4. White metal recovery
5. Lead recovery

In addition to these emissions, the handling of the various feed materials for the smelter complex, the historical slag stockpiles and fill, slag by-products, and other waste materials, coupled with operational truck traffic on metallic slag-filled areas, produced fugitive dust particles containing metals that were allowed to blanket the surrounding areas uncontrolled, including the adjacent former Reichhold site. The ground surface itself was used to store concentrates or scrap metal for processing, contributing to direct ground contamination. Areas where these operations were conducted have become local hot spot areas for heavy metal contamination of soils and sediments. To further complicate the history of USMR's contamination, several processing operations were initiated over the years as specific economics became more or less favorable for a given smelting/recovery process; thus, a variety of raw materials and resulting wastes were brought onto the property and dispersed into the local environment.

These various processes at the USMR facility at 400 Middlesex Avenue generated a variety of waste slag materials containing heavy metals. For decades prior to selling a portion of this property to Reichhold, USMR disposed of those materials on that portion. USMR documents indicate how USMR used slag to fill the intertidal zone along the Arthur Kill, presumably to dispose of the slag and increase the footprint of the property. Later environmental investigations revealed that the slag fill materials contained lead, cadmium, copper, zinc, arsenic, selenium, nickel, and other metals, at concentrations significantly above the NJDEP criteria. These historic fill slag disposal practices contaminated soil,

groundwater, and likely contaminated sediment at the USMR facility as well as at adjacent properties and likely contaminated the sediment and surface water of the Arthur Kill.

However, as documented in this report, USMR did not delineate these impacts beyond its current property boundary even though it was required to do so under an Administrative Consent Order (ACO) with NJDEP dated January 1988, updated April 1994. In fact, observations made by CH2M HILL in May 2007 and April through June 2008 indicate that waste slag material continues to be exposed at the former USMR property near the Arthur Kill intertidal marsh area zone, in the southern portion of the current USMR property on Tufts Point Marsh, adjacent to the former Reichhold southeast property boundary.

While there are no data regarding the specific contamination generated by the operations of this lead plant, it is likely that it would have contributed to the metals contamination in the Arthur Kill and surrounding marsh area through its history of operation (from about 1931 through about 1952) caused primarily by USMR operations at its facility at 400 Middlesex Avenue.

USMR also discharged wastewater and stormwater containing high concentrations of metals and organics to the Arthur Kill during its history of ownership. Section 3 of this report summarizes the USMR processes and operational procedures affecting surface water and sediments. Historical photographs presented in this report show how storm water and wastewater discharges from the USMR facility to the Arthur Kill were uncontained. USMR documents and process design drawings show that USMR discharged wastewater contaminated with metals, oil, and grease directly to the Arthur Kill through process outfalls and stormwater runoff. Historical aerial photographs provided in this document show that stormwater runoff controls were apparently not employed for the metal slag stockpiled on Tufts Point Marsh near the Arthur Kill, allowing metal slag to be continually washed into the surface water and sediments of the Arthur Kill.

In addition, the New Jersey Public Interest Research Group (NJPIRG) and Friends of the Earth sued USMR on May 27, 1986, for repeated violations of its National Pollution Discharge Elimination System (NPDES) surface water discharge limitations to the Arthur Kill. Information presented in the lawsuit indicated that USMR violated its NPDES permit nearly 500 times. The permit violations consisted primarily of discharges of metals, oil and grease; and pH and temperature above permitted levels. USMR ultimately lost the lawsuit, obligating it to pay a substantial amount in fines for repeated NPDES violations. Although required by the second of its two ACOs with the NJDEP, dated January 22, 1988 and amended April 1994, USMR did not investigate the impacts from these repeated discharge violations to sediments in the Arthur Kill. On June 25, 2007, NJDEP filed litigation against USMR for natural resources damages from discharges of pollutants and hazardous substances emanating from operations at the facility. Among other actions, NJDEP is requesting in that lawsuit that USMR be compelled to perform a baseline ecological evaluation of sediments and surface waters in the Arthur Kill.

Records, including numerous NJDEP inspection reports, indicate that USMR had significant difficulty meeting air emissions requirements of the Clean Air Act. For example, NJDEP site inspectors in May and June of 1982 reported observing "heavy black smoke", white haze", "100 percent opacity, and "heavy" black and white fugitive emissions coming from various portions of the USMR property. Historic and regulatory documentation, as well as air

emissions monitoring and modeling information indicate that regulated metals including lead were deposited through air emissions from USMR operations over the surrounding area and region.

The State of New York also sued USMR on March 11, 1983 for the negative impacts of air emissions on Staten Island across the Arthur Kill from the USMR facility. Historical eyewitness accounts by citizens living on Staten Island indicate that the emissions visibly affected Staten Island and were not only an odor nuisance, but had adverse effects on crops (New York State Department of Environmental Conservation, 1984). Information presented during litigation showed that lead was deposited on Staten Island from USMR emissions. The lawsuit was eventually settled, with USMR paying for remediation of hot spot lead-contaminated soil on Staten Island resulting from USMR's emissions.

Based upon our technical evaluation of information for the former Reichhold and USMR sites in Carteret, New Jersey, Reichhold's ISRA obligations should not include metals impacts in environmental media, since the use of metals was not a significant part of operations at the former Reichhold site. Reichhold owned its former site from 1960 to 1986; whereas, USMR's local and regional environmental impacts from multimedia discharges of metals began affecting the area from 1902 when USMR first operated the smelter and continued through the USMR facility closing in 1986.

The overwhelming source of metals on and near the former Reichhold site is from USMR operations. The metals were deposited on that property by USMR prior to Reichhold's ownership and operation and migrated on to the Reichhold site from adjacent USMR operations from several media before, during, and after Reichhold's tenure. Significant releases of metals in surface water discharged to the Arthur Kill from USMR occurred over decades, as acknowledged by USMR in the monthly DMRs and other documents that it prepared. Environmental impacts to the surrounding properties and the Arthur Kill remain unaddressed by USMR. Visual observations made and photographs taken in May 2007 and in April through June 2008 of the southwestern portion of the USMR property indicate that slag is still exposed over 20 years after USMR operations ended, on the ground surface and in sediments on and near the USMR property along the Arthur Kill. Additionally, USMR's process of pumping metals-contaminated groundwater from the USMR property, removing the chlorobenzene but not the metals, and spray irrigating the water back onto the former Reichhold property has likely redeposited metals, further spreading and adding to the surface soil and groundwater metals contamination on the former Reichhold property.

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Acronyms and Abbreviations

µg/L	micrograms per liter
ACO	Administrative Consent Order
The Act	Federal Water Pollution Control Act
BTL	Bakelite Thermoset Limited, Inc.
DMR	Discharge Monitoring Report
EPA	U.S. Environmental Protection Agency
ECRA	Environmental Cleanup and Remediation Act
FS	Feasibility Study
ISRA	Industrial Site Recovery Act
GWQS	Groundwater Quality Standards
kg/day	kilograms per day
lbs/hr	pounds per hour
mg/kg	milligram(s) per kilogram
mgd	million gallons per day
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NJPIRG	New Jersey Public Interest Research Group
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRD	Natural Resource Damages
PCE	tetrachloroethene
ppm	part(s) per million
RI	Remedial Investigation
SIP	State Implementation Plan
Staflex	Staflex Specialty Esters, Inc.
USMR	U.S. Metals Refining Company

Acronyms and Abbreviations (cont.)

TCE	trichloroethene
VOC	volatile organic compound
yd^3	cubic yard

SECTION 1
Introduction

This report summarizes historical and lingering environmental impacts to the region surrounding the former USMR operations at 400 Middlesex Avenue in Carteret, New Jersey. Historical environmental documents and data indicate that the USMR facility had a substantial negative environmental impact on the regional area. Air emissions data and air modeling studies indicate that for decades, the deposition of particles containing lead and other metals from USMR facility emissions contaminated adjacent properties as well as residential areas east of the Arthur Kill and the USMR facility and south onto Staten Island, New York. Environmental investigations and remedial actions conducted by USMR and others to date have established that releases from USMR operations contaminated soil and groundwater above NJDEP criteria. However, as documented in this report, USMR failed to delineate impacts from its past operations and disposal activities beyond its current property boundaries. In fact, despite the implementation of a final remediation remedy, slag waste materials remain exposed at the ground surface on USMR property near the Arthur Kill.

The environmental impacts described in this document originated from four primary USMR sources: land disposal of waste slag and secondary scrap metal, air emissions and resulting deposition of metals, groundwater impacts from operations at the site, and surface water discharges containing metals and other regulated materials. Based on current site conditions, impacts from these sources, specifically to offsite locations, remain unaddressed. The regulatory and litigation history indicate that the facility had ongoing compliance issues regarding air emissions, slag disposal, and wastewater discharges, resulting in releases of significant volumes of regulated materials to the environment. A brief timeline summarizing notable events is provided in Section 7.

As described in this document, delineation of USMR's environmental impacts to surrounding properties, including the former Reichhold site (consisting of the northern Staflex parcel and the southern BTL parcel) which USMR at one time owned, remains unaddressed. One of the most significant unaddressed areas of environmental impact is the Arthur Kill. The effects of decades of documented process and stormwater discharges containing metal wastes and air deposition from plant emissions have not been evaluated in the sediments of the Arthur Kill.

1.1 Site History

The original USMR facility was built in Carteret, New Jersey in 1901 (Rolle, 1952) as a primary copper smelter and over its period of operations was also used to process secondary scrap aluminum, produce inorganic copper fungicide, process solder from old radiators, etc., depending upon the changing market economics of each operation (Richard S Kunter & Associates, February 2006). The facility expanded to more than 200 acres from 1901 through 1970 (HydroQual, 1988a). In 1920, USMR became a wholly owned subsidiary of the American Metal Company, Ltd., which eventually became AMAX, Inc.

Appendix A shows the gradual expansion of the USMR facility (HydroQual, 1988a) to over 200 acres. The original facility was expanded with the addition of a smelter and several furnaces. As described by HydroQual (1988a), "Additional property was acquired, including areas to the south, for slag disposal." In 1930, the facility expanded as it acquired the Metal and Thermit Corporation. In 1967, the Armour Fertilizer Works property was acquired, its facility was demolished, and the land was used as a scrap storage yard. In 1969, the Chrome Steel Works property north of the facility was acquired and the land was eventually used for storage of used equipment. Sanborn® maps from 1924, 1931, and 1950 (Appendix B) also show the development of the area. The USMR lead plant is depicted on the 1950 Sanborn® map south of the railroad tracks.

The expansions included adjacent land to the west used for a lead plant. This land was later sold to Reichhold, Inc. (Reichhold) in 1960. The lead plant was not identified in the referenced HydroQual report.

1.2 Historical Extent of USMR Facility

Construction of the copper refinery, then known as DeLamar's Refining Works, was begun in 1901(Rolle, 1952). The facilities were later expanded to include a smelter and several furnaces. The smelter was first operated by USMR in 1902. A considerable variety of smelting operations were conducted at the Carteret site over the life of the operation.

Additional property was acquired, including the areas to the west apparently for slag disposal. In 1930, the Chrome Steel Works was acquired, and the plant further expanded. In 1967, the Armour Fertilizer Works (Appendix B), which burned sulfur to produce sulfuric acid, was acquired, the buildings demolished, and the land used for scrap storage. In 1969, the Metal and Thermit Corporation property, north of the plant, was acquired, where tin recovery and refining had been conducted. The land was used as a disposal site for old equipment. By 1970, the current property boundaries were established.

The location of the USMR facility shown in documents submitted to NJDEP by USMR and its environmental consultant, HydroQual, have historically depicted the facility as the property boundary at the time of the submittal of documents in the late 1980s (Appendix A). These reports omitted the true historical extent of the property, which includes the former USMR operations on the former Reichhold property, which would have given NJDEP a better indication of whether the environmental impacts from the facility had been properly delineated. As shown in figures from HydroQual (1988a), provided in Appendix A, the western extent of the property is delineated to the slag storage area. However, there is an additional 45+ acres of land west of the slag storage area that was once part of the USMR facility and later sold to Reichhold, as noted on Figures 1-1 through 1-4. As evident from some of these figures, the southern and western portions of the former Reichhold property were used as a slag disposal area. In fact, test pits, foundation excavations, and monitoring well construction activities at the former Reichhold property, which Reichhold acquired from USMR in June 1960, indicated that Reichhold had built its operating facilities over fill material (CH2M HILL, 1985). This fill material consisted of metal slag, brick, road material and miscellaneous other materials. In the same correspondence, CH2M HILL also noted that the southwest portion of the former Reichhold site was used by USMR to dispose of 'waste substances' from past operations.

This major component of the former USMR facility was omitted from the Remedial Investigation (RI) reports submitted to NJDEP by USMR and included a large lead plant operated by USMR on the former Reichhold property. This plant was one of the seven main divisions of the smelter that was dismantled (USMR, 1952). This portion of the property was purchased by Reichhold in 1960 for manufacturing, primarily organic compounds including phenolic resins and plasticizers. As shown in Figure 1-2, the USMR lead plant was actively operated adjacent to the main USMR facility. The photograph also shows a significant amount of slag around the former lead plant, as well as what appear to be direct plant process discharges towards or into the Arthur Kill.

1.3 Site Processes

Construction of the original USMR facility was begun in 1901 as a primary copper smelter. Over its period of operations, the facility was also used to process secondary scrap aluminum (1943 through approximately 1954), produce an inorganic copper fungicide (1940 to 1960), process solder from old radiators (unknown start through late 1950s), etc., depending upon the changing market economics of each operation (Kunter & Associates, 2006). From 1927 through the late-1940s, zinc captured in flue gases was precipitated and sold as zinc oxide. Zinc leach residue was smelted to produce white metal (alloys of tin and lead, with or without antimony). Refinement of these alloys produced additional alloys for solder (Kunter & Associates, 2006). In 1934, a "selenium plant" was expanded to refine and recover tellurium. A germanium recovery unit was in operation from 1957 through the mid-1960s. Towards the latter part of its operational history, the facility was used to process metal-bearing scrap and recover several precious metals (iridium, tellurium, rhodium, ruthenium, gold and silver). The raw materials for the USMR secondary copper smelter included shredded telephones and switchboard equipment, iron, brass, discarded electrical equipment, and other copper-bearing materials (PEDCo Environmental, 1982).

Lead was present in the copper ores, and was one of the metals (along with zinc and tin) in the slag left over after recovery of copper. One place for disposal of slag was the area south of the former smelter, with slag elevations reportedly reaching approximately 35 feet above surrounding grade (Hydroqual, 1987). Slag from an electric arc furnace that was in service from 1972 to 1986, was also discarded in numerous slag piles on the USMR property, including in its southwest area, immediately east of the former Reichhold property.

The USMR facility also operated a lead smelting unit in the southern portion of the former Reichhold site from an unknown start date, until at least 1951 (letter from Joseph Scholz to William Ruskin; August 3, 2006). It is known that the lead plant was in operation by 1931.

As described by USMR (1972), the facility performed three separate functions using the following primary operations:

1. Smelting and refining copper-bearing materials, including high- and low-grade scrap
2. Producing standard and unconventional copper
3. Smelting and refining scrap materials bearing precious metals

In addition, USMR also performed rolling and casting of metals and transported finished products offsite by railroad. The railroad also transported raw materials used for facility operations. USMR smelting operations also involved shipment of ore material from docks.

A variety of materials containing metal components was processed at the USMR facility to recover copper and precious metals, including batteries, automotive parts, electric motors, and insulated wire (USMR, 1972). According to USMR (1972), wire processed at the facility contained more than 600 types of insulating materials, including polyvinyl chloride, neoprene, rubber, and asphaltic substances. Open burning of large quantities of insulated copper wire was standard practice until the advent of air pollution abatement laws in the 1960s (Kunter & Associates, 2006).

During the 80 years that the smelter operated, it emitted particles and gases into the atmosphere from five separate operations areas and produced localized hot spots of contamination from ground spills containing metals. The operations consisted of:

1. Smelting, converting and refining
2. Reverberatory furnace refining and casting
3. Precious metals refining
4. White metal recovery
5. Lead recovery

Waste products from the USMR operations included dust and metal slag that were released to the environment through direct land disposal, deposition from emission sources, and wastewater discharges. Various areas of the property were used over the years to store concentrates for processing, and scrap copper for feedstock to the cupola or wire furnaces, contributing to direct ground contamination. Metals contained in the slag waste stream included lead, arsenic, chromium, copper, and zinc (HydroQual, 1987). The plant air emissions contained metal particles, including lead, cadmium, copper, zinc, and iron (Kellogg, 1961). Metals contained in the process wastewater and stormwater runoff were discharged to the Arthur Kill (NJPIRG, 1986). Impacts from these waste disposal practices are summarized in later sections of this report.

SECTION 2

Land Disposal

This section discusses the environmental effects from USMR's land disposal of waste slag materials containing heavy metals at the Carteret site.

2.1 Land Disposal of Slag Containing Metals

The NJDEP, in accordance with the Brownfield and Contaminated Site Remediation Act (N.J.S.A. 58:10B-1 et seq.) has prepared maps of the entire state of New Jersey that show the locations of historic fill. Historic fill is defined by the NJDEP as "non-indigenous material placed on a site in order to raise the topographic elevation of the site." The NJDEP notes that "some areas mapped as fill may contain chemical-production waste or ore-processing waste that exclude them from the legislative definition of historic fill." Figure 2-1 depicts the extent of historic fill as mapped by the NJDEP, for the USMR site and surrounding area. As depicted on Figure 2-1, the entire eastern and southern portions of the USMR site, on the banks of the Arthur Kill, and portions of the former Reichhold site have been filled in. The extent of historic fill in the southern portion of the USMR site (Tufts Point) is especially widespread, extending approximately 1,000 feet inland from the shoreline.

On the USMR property, one estimate of historic slag disposal, not counting the aboveground piles of slag, was approximately 852,000 cubic yards (HydroQual, 1987). USMR used approximately 36,000 cubic feet of this slag to construct a haul road across the northwestern portion of the former Reichhold site (termed the Staflex Parcel, Figure 1-1). The slag haul road was constructed in the 1950s and was used to transport slag material offsite to be used as commercial fill for the construction of the New Jersey Turnpike (Tennant, 1950). This same estimate (HydroQual, 1987) also indicated that in the southern area of the USMR site known as Tufts Point (originally a marsh area), slag thickness was between 20 and 30 feet in places. Historical USGS topographic maps (Appendix D) and aerial photographs and descriptions indicate that Tufts Point was at one time a low-lying tidal marsh area (Tufts Point Marsh), adjacent to the Arthur Kill. The low-lying areas, and several other noteworthy features including the slag piles in various locations on the former Reichhold property, and the slag haul road leading from the large slag pile in the southern portion of the USMR property northwest, are visible on Figure 2-2 (1954 aerial photograph), Figure 2-3 (aerial photograph from 1963) and Figure 2-4 (aerial photograph from 1984). Figures 2-3 and 2-4 (aerial photographs from 1963 and 1984, respectively), show overlays of the maximum extent of the 500-year Flood Plain, the New Jersey State Tidelands Claim Line, the edge of water approximate high tide, and the 10-foot elevation contour, based on a June 2008 survey. As visible on these two figures, there are very few changes along the Arthur Kill shoreline on the former Reichhold property during these more than 20 years. The years of the aerial photographs correspond approximately to the beginning (1960) and end (1986) of Reichhold's ownership of the property. Demolition debris was also placed in the southwest corner of the USMR site in an area known as the 'Dump Area', adjacent to the southeast corner of the former Reichhold site.

Because of the tremendous volume of slag materials disposed of at the former Reichhold site by USMR, estimated at approximately 65,000 cubic yards (Haley and Aldrich, 2006) and 252,000 cubic yards (CH2M HILL, 1985), and its widespread occurrence, the primary waste management approach has been to cap and contain the material onsite. However, prior to the promulgation of Environmental Cleanup and Remediation Act (ECRA) and Industrial Site Recovery Act (ISRA) regulations, USMR, for several decades, did not perform waste management under regulatory authority or supervision, leading to uncontrolled disposal of material, as described in this and in the following sections. Because waste management in the decades prior to the enactment of federal and state regulations was unsupervised, there was no formal 'closure' of waste management activities.

On January 22, 1988, AMAX formerly USMR entered into an Administrative Consent Order (ACO) with NJDEP (Appendix E; NJDEP, 1988). The excerpts below from the FINDINGS of the ACO which was signed by both AMAX/USMR and NJDEP indicate:

> *"8. In 1985, AMAX initiated its own ground water investigation at the site and since that time AMAX has installed twelve monitor wells, twelve investigative monitor wells and twelve piezometers. Laboratory analyses of samples collected from the wells and submitted to the Department reveal that the ground water at certain areas of the site including but not limited to wells 17I, 13I, 18I, 10H, 11H, 12H, BH7, BH8, and BH13 contains elevated concentrations of heavy metals including copper, zinc, selenium, nickel, arsenic, cadmium and lead which exceed the New Jersey ground water quality standards of N.J.A.C. 7:9-6.1."*

> *"12. On November 26, 1986 AMAX submitted EP Toxicity analyses of composite slag samples to the Department. These samples were taken from slag stockpiles at the south end of the site. This area has been used to dispose of large quantities of smelter slag by landfilling and stockpiling during the years of the smelter's operations. In certain portions of this area, slag fill may extend down as much as thirty (30) feet. EP Toxicity analyses of the slag samples taken from the stockpiles revealed elevated levels of lead and cadmium. These levels are not high enough to be considered hazardous waste pursuant to N.J.A.C. 7:26-1 et seq., but these levels are higher than existing ground water quality criteria of N.J.A.C. 7:9-6.1. In addition, AMAX contends that a different type of analysis using distilled water would more accurately define leaching from the slag to ground water."*

> *"13. The heavy metals described in paragraphs eight (8) and twelve (12) above are hazardous substances under the regulations at N.J.A.C.7:1E-1 et seq. promulgated pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq."*

If engineering controls (*i.e.*, capping) are used for capping contaminated materials, NJDEP requires that the area of concern be inspected on a regular basis to ensure that the engineering controls are effectively containing the materials. However, visual reconnaissance of the USMR property by CH2M HILL in May 2007 and on several occasions in April through June 2008 revealed that exposed slag still remains on the USMR site in ecologically sensitive areas. Photographs from these site visits are presented in Appendix C, which show that slag materials remain exposed near the intertidal zone of the Arthur Kill located on the current USMR property. As shown in the photographs, areas of coarse black slag are located downgradient of the USMR stormwater holding pond in areas that is exposed to surface water runoff and in the sediments at the shoreline of the Arthur Kill. There is no indication that USMR is addressing these areas or that NJDEP is currently aware of these conditions. Routine visual inspections of engineering controls, if conducted, should

have revealed the presence of this slag. This material may have been exposed at the surface due to continuing erosion of fill from the USMR site, which acts as a continuing source of contamination to the Arthur Kill. Based on USMR estimates (HydroQual, 1987; Haley & Aldrich, 2006) 852,000 cubic yards of slag was used to fill in areas of the USMR site. In addition, by USMR's own estimate (Haley and Aldrich, 2006), approximately 65,000 cubic yards of slag containing metal was disposed of by USMR on the southern portion of the property that was sold to Reichhold in 1960. Reichhold estimates that the volume of slag and fill materials deposited by USMR on its former property is nearly four times that volume, or about 250,000 cubic yards (CH2M HILL, 1985). Given that slag materials are exposed on the USMR property to this day, Reichhold believes there would be no environmental benefit in attempting to cap historical fill wastes in the tideland areas adjacent to the former Reichhold site; any capping activities would likely be compromised, at a minimum, by erosional runoff and redeposition of the exposed slag on the USMR property

As documented in Section 2.1.2, a tremendous volume of slag was stockpiled and disposed of onsite by USMR, including the adjacent tidal wetlands and marsh areas of the Arthur Kill. However, there is no indication that USMR sampled sediments in the Arthur Kill for the presence of slag and/or metals, which is also a requirement of the Technical Requirements for Site Remediation (N.J.A.C. 7:26E-3.11), which states: "A baseline ecological evaluation shall be completed for each contaminated site or area of concern."

2.1.1 Slag Metals Composition

Slag, as referenced in this document, is a residue generated from USMR metal smelting operations and is most commonly characterized as black, fine-grained, sand-like material. USMR historically disposed of a portion of its slag by using it to fill in low-lying areas along the Arthur Kill. USMR stockpiled the slag and disposed of it in significant quantities on the USMR property and the former Reichhold property (HydroQual, 1987). The cupola (smelter) slag composition is listed in Table 2-1 (HydroQual, 1991).

TABLE 2-1
Average Percent Cupola Smelter Slag Composition (1968 to 1984)

Parameter	Percent Average Composition (by weight)
Iron	44.2
Silica	27.6
Aluminum	8.1
Calcium	4.8
Zinc	3.6
Copper	1.18
Lead	0.75
Nickel	0.44
Tin	0.28
Sulfur	0.10
Antimony	0.08
Arsenic	0.06
Selenium	0.013
Tellurium	0.010
Total	**91.213**

The actual composition of slag materials disposed of on the USMR site, and later sampled, yielded higher composition of metals (HydroQual, 1987) than reported in Table 2-1. It is noted that the number of samples analyzed by USMR was not sufficient to characterize the metals concentrations from the variety of operations that occurred at the facility. The 1991 Feasibility Study (FS) states that the manufacturing process produced slag with metals of varying composition (HydroQual, 1991). It is unclear whether the slag containing the highest concentration of metals was characterized for toxicity characteristics. Table 2-2 shows the percent composition of metals in samples collected from three onsite slag disposal areas by USMR's consultants (HydroQual, 1987).

TABLE 2-2
Percent Composition of Lead, Zinc, and Copper in Slag Fill Areas (April 10, 1987)

Metal Parameter	Percent Metal Composition (by weight)
Lead	4.00
Zinc	8.82
Copper	7.10

Additional sample results indicated that other metals, not included in Tables 2-1 and 2-2, are associated with slag disposal areas. The maximum concentration of metals in soil boring samples collected from slag disposal areas included arsenic at 3,460 milligrams per kilogram (mg/kg), cadmium at 8,000 mg/kg, chromium at 3,000 mg/kg, and selenium at 671 mg/kg (HydroQual, 1987).

2.1.2 Slag Disposal Amounts

The slag, as well as potentially off-specification raw materials, alloying materials, and finished products, were disposed of onsite, allowing USMR to profit not only by avoiding disposal costs, but also by expanding the footprint of its facility. Approximately 852,000 cubic yards (yd^3) of slag (ranging from 613,500 tons to 1,125,000 tons, depending upon the density of the slag) were used as fill in portions of the former USMR facility now owned by USMR (HydroQual, 1987). In addition, Reichhold estimates that USMR disposed of approximately 250,000 cubic yards of slag (ranging from 180,000 tons to 330,000 tons; depending on the density of the slag), in the southern portion of its facility (on the former Reichhold property) (CH2M HILL, 1985). HydroQual reported that southern portions of the site were once coastal wetlands and were later filled in with slag to depths of up to 30 feet in order to accommodate USMR operations (HydroQual, 1987). This statement is supported by the 1900 and 1955 U.S. Geological Survey topographic maps (Appendix D), which depict wetlands or marsh areas along the shoreline surrounding the former USMR property. This historical shoreline is shown in an aerial photograph from 1943 (Figure 1-2) where the relief between the land surface near the lead plant and the adjacent tidal wetlands and marsh areas of the Arthur Kill is quite apparent. Figure 2-2 provides an aerial photograph from 1954, which shows this shoreline tidal wetland marsh area as being filled with slag sometime in the eleven years after the previous aerial photo was taken. This area of slag in-fill has not been disputed by USMR and was subject to an engineering cap in 1994 in which USMR contributed payment.

In addition, as noted in Section 2.1, USMR used approximately 36,000 cubic feet of slag to construct a haul road across the northwestern portion of the former Reichhold site. This haul road was described as being 40 feet wide, 450 feet long and 2 feet deep (Runyon, 1996). According to Runyon, USMR calculated the volume of slag dumped on the slag haul road area for disposal estimation purposes; however, USMR did not remove the slag. The location of the haul road corresponds with the approximate locations of the areas termed the northwest and northeast fields on the Staflex parcel. NJDEP required Reichhold to delineate and remediate the slag from this haul road in the course of its ISRA obligations. The path of the haul road is adjacent to existing residential units along the east end of Bergen Street in Carteret (see Figures 2-2, 2-3, and 2-4).

2.2 Offsite Groundwater and Soil Impacts

The following subsections describe offsite delineation issues relating to groundwater and soil.

2.2.1 Groundwater

USMR's historical operations and continued presence of slag and other metal-bearing waste has caused groundwater in the area to be contaminated with metals and chlorinated volatile

organic compounds (VOCs). Copper smelters and refineries typically use fuel to produce the energy required for the high-temperature reactions necessary in the smelting and refining of copper. These sources of fuel include distillate oils such as fuel oil, kerosene, and residual oil (NJDEP, 1985). The secondary sources of copper (i.e., not raw copper ore) may include copper-bearing electrical equipment and insulated wires.

AMAX/USMR as noted in Section 2-1 entered into an ACO with NJDEP on January 22, 1988 (Appendix E). The ACO Findings indicated that the heavy metals copper, zinc, selenium, nickel, arsenic, cadmium, and lead were found in many monitor wells on the USMR site at concentrations which exceed the New Jersey (Groundwater Quality Standards) GWQS. The former Reichhold site is located hydrogeologically downgradient of the USMR site.

A spill of chlorobenzene occurred on the USMR property in the 1960s, near the railroad and Middlesex Avenue (NJDEP, 1996). The spill was discovered during demolition activities by USMR, in the 1990s. Although USMR excavated and disposed of contaminated soil, there was considerable groundwater impact from this spill, both on the USMR property as well as in hydrogeologically downgradient portions of the former Reichhold property. The plume has migrated at least 800 feet from the source (Appendix G; Figure 1-10).

In a March 16, 2006 letter, NJDEP required USMR to expand its Classification Exception Area to include the metals contamination on the Reichhold site. Additionally, NJDEP required that USMR include Reichhold's wells in its long-term monitoring program. Based on groundwater flow direction, the nature of contamination, and information available from NJDEP, it is apparent that USMR's extensive heavy metals and VOC groundwater contaminant plumes are migrating onto the former Reichhold property and USMR historical operations have contributed to groundwater contamination on the former Reichhold property (Appendix G; Figure 1-9 and Figure 1-10). Additionally, as described below, Reichhold's operations at its former site did not include the extensive use of heavy metals.

Reichhold's primary operations at its former site included manufacture of phenolic resins, molding compounds, specialty esters, plasticizers, and polyester resins. Molding compounds were manufactured by blending phenolic and/or polyester resins with cellulosic and mineral fillers, initiators, inhibitors, and minor additives. The specialty esters unit produced esters, plasticizers, and polyesters by the reaction of various acids and anhydrides with alcohols and glycols, in the presence of catalysts and minor additives (O'Brien and Gere, 1986). Metals were not used extensively in Reichhold's operations; the metals used as part of Reichhold's operations were limited primarily to zinc stearate (used in blending the molding compounds) and zinc acetate (additive to phenolic resin) (CH2M HILL, January 2006). Zinc, in non-elemental compound form, has not been deemed a contaminant of concern at the Reichhold property. Metals were a de minimis component of Reichhold's operations and were bound with other chemicals in the form of catalysts. The heavy metals associated with USMR's operations (including copper, zinc, selenium, nickel, arsenic, cadmium, and lead) did not originate with Reichhold's past operations, and should not be part of Reichhold's ISRA obligations.

The 1988 ACO between AMAX/USMR and the NJDEP requireed that AMAX/USMR *"fully determine the nature, type and physical states of soil, surface water and ground-water pollution at and/or emanating from the site."* As indicated in the January 22, 1988 ACO (Appendix E; NJDEP, 1988), AMAX/USMR was also required under the ACO (Appendix A Remedial

Investigation Scope of Work); *"to fully determine the horizontal and vertical extent of pollution at and/or emanating from the site"* and; *"Fully determine migration path of pollutants through air, soil, groundwater, surface water and sediment both on and off site,"* and; *"Fully determine impact of the pollution on human health and the environment."*

Additionally, as documented in a letter from CH2M HILL on behalf of Reichhold, to NJDEP, there is no readily identifiable onsite source area for chlorinated VOCs detected in monitoring wells on the former Reichhold site (CH2M HILL, 2006b). Chlorinated VOC impacts to groundwater beneath the former Reichhold site appear to be from the USMR site based on composite groundwater analytical data and groundwater flow direction (Appendix F). The figure in Appendix F shows the chlorinated VOC data from both USMR and Reichhold monitoring wells, with groundwater elevation contours and flow direction details illustrating the hydraulic connection between the USMR property and the former Reichhold site. As is apparent from the figure, tetrachloroethene (PCE) and trichloroethene (TCE) were detected on the USMR property in the late 1980s at concentrations as high as 7,800 and 3,690 micrograms per liter (μg/L) (MW-13I), respectively. These concentrations significantly exceed the Ground Water Quality Standard of 1 μg/L for both compounds and were detected in USMR groundwater located hydraulically upgradient, just east of the former Reichhold property line. The concentration of these chlorinated VOCs on the downgradient Reichhold property were substantially (i.e., two to three orders of magnitude) less than those detected on the USMR site, which is the likely source for the diffuse occurrence of the chlorinated VOCs detected in groundwater on the former Reichhold property.

Chlorinated VOCs extend from the USMR property all the way to the southwest portion of the BTL parcel. On the adjacent west portion of the USMR property, PCE concentrations of up to 1,130 μg/l was detected in monitoring well MW-60I in 1988-1989. This well is located approximately 800 feet east of the former Reichhold site. In the upgradient (north) portion of the plume, PCE and TCE concentrations of up to 784 μg/l and 188 μg/l, respectively, were detected in USMR monitoring well MW-13I in June 1990, located less than 50 feet east of the former Reichhold site. As noted from the Appendix F figure, groundwater elevation contours (June 2001) indicate that the USMR site is hydraulically upgradient of the former Reichhold site and groundwater appears to flow radially away from a mound located in the central portion of the USMR site.

In addition to the upgradient source, USMR conducted pump and treat remedial activities for chlorobenzene in the vicinity of monitoring well MW-13I, whereby a portion of the treated water was discharged to the ground surface on the former Reichhold property by 'spray irrigation' between April 1996 and April 2000. MW-13I is directly upgradient of monitoring wells MW-32, MW-34, and MW-37 on the former Reichhold property. It is also noted that USMR utilized an injection trench on the former Reichhold property as part of its remedial activities (Appendix G; AMAX Figure 3). Groundwater in this portion of the USMR property also contained concentrations of metals above NJDEP groundwater criteria (HydroQual, 1990). The recovered groundwater was not treated for metals nor monitored before discharging onto the former Reichhold property. As shown in Appendix G (Figures 1-9 and 1-10), the groundwater metals, chlorobenzene, and chlorinated VOC plumes overlap, indicating that a variety of contaminants would be recovered with the chlorobenzene while the groundwater pumping system was in operation. Clearly, these

pump and treat operations would have affected the local groundwater hydraulics. Spray irrigation and trench infiltration could also explain the distribution of chlorinated compounds detected in monitoring wells on the former Reichhold property, for which an on-site source has not been identified. In short, the USMR remedial activities, while no doubt designed to reduce the level of groundwater contamination on the former USMR property, had the clear potential if not the likely effect of increasing and exacerbating groundwater contamination on the former Reichhold property.

In spite of these groundwater contamination problems associated with the USMR site, there is no apparent indication from reports to NJDEP that USMR has delineated metals contamination occurring in soil, sediment or groundwater beyond its current property boundary. In fact, USMR did not present groundwater quality data on isoconcentration maps, a requirement of the 1988 ACO (NJDEP, 1988). Appendix A, Part III of the ACO states the RI report should contain "groundwater quality contour map(s) and cross section(s)." Had these data been presented, it would be clear that groundwater contaminants beyond the USMR site were not delineated.

2.2.2 Soil

As noted previously, historical operations at the USMR facility are the primary source of metals contamination in soils on the former Reichhold site and the region through historical fill discharge and disposal of wastes. This included direct land disposal of metal slag on the former Reichhold site, historical fill, metals deposition from air emissions, and discharges of wastewater and stormwater to the Arthur Kill.

The extensive use of metals was not part of operations at the former Reichhold site. The overwhelming source of metals on and near the former Reichhold site is from USMR's operations; the discharges of metals from the USMR property took place for several decades prior to, and during Reichhold's ownership of the site. As noted earlier, photographs of the southwestern portion of the USMR property, taken from the southeast portion of the former Reichhold site in May 2007 and in April through June 2008, indicate that slag still remains exposed on the ground surface and in sediments on and near the USMR property and along the Arthur Kill.

Soil analytical results from samples collected from the Staflex parcel (O'Brien & Gere, 2002) indicate exceedances to the NJDEP RDC criteria for several metals, including, but not limited to lead, copper, antimony, cadmium, nickel, zinc, and arsenic. These samples were collected from the top 6 inches of the ground surface. In these samples, lead was detected at levels as high as 94,200 mg/Kg. Similarly, soil analytical results from samples collected from the northern and western edges of the BTL parcel, over June 1997-September 2001, indicate that the above metals exceeded NJDEP RDC criteria at depths up to 7 feet below ground surface. In these samples, lead was detected at up to 12,400 mg/Kg, from 1.5-2 feet below ground, in a sample collected from near the former USMR lead plant. These are the same heavy metals identified on the Table 2-1 Average Percent Cupola Slag Composition (1968-1984) and the January 22, 1988 ACO. Additionally, the levels of lead detected are comparable to the percent heavy metal levels on Table 2-2 Percent Composition of Leads, Zinc, and Copper in Slag Fill Areas (April 10, 1987). This would further indicate that the source of these metal exceedances are the USMR slag materials dumped on the Staflex

property to construct a haul road in the 1950's and the USMR slag materials used to fill the Marsh Areas near the former USMR lead plant from the early 1900's through the 1950's.

USMR has not delineated the occurrence of metals originating from its operations. NJDEP indicated that USMR was responsible for the presence of metals on the former Reichhold property in its August 9, 1999 letter. In this letter to the USMR, NJDEP stated:

> *The widespread occurrence of slag has been attributed to the operations of the former US Metals Refinery Company which operated at the site prior to Reichhold Chemicals, Inc. and on the adjacent property to the east…Reichhold Chemicals, Inc. is not required to delineate the elevated metals beyond its property boundaries.*

Metals contamination from the USMR facility was not delineated beyond the current property boundary, even though soil isoconcentration maps submitted by USMR clearly showed metals constituents at concentrations well above NJDEP criteria along the USMR and former Reichhold property boundary (CH2M HILL, 2006). Site soil and fill isoconcentration maps submitted to NJDEP by HydroQual are provided in Appendix H. As shown in Appendix H, the soil constituents are delineated up to the property boundary, and the isoconcentration lines indicate that metals contamination most likely continues beyond the property boundary onto the former Reichhold property. In addition, data presented by HydroQual showed metals concentrations in fill material at very high levels at the property boundary between USMR and the former Reichhold property (HydroQual, 1990). In fact, HydroQual's Special Report on Slag Area Groundwater (HydroQual, 1990) reported lead concentrations in the slag fill exceeding 10,000 parts per million (ppm) at the property line, which is substantially above the NJDEP non-residential soil cleanup criteria of 600 ppm. Additionally, concentrations of zinc at the property boundary were reported to exceed 100,000 ppm, well above the NJDEP non-residential cleanup criteria of 1,500 ppm.

In addition, elevated lead concentrations detected in the soils adjacent to the former lead manufacturing facility on the former Reichhold site are consistent with lead discharge from that facility. The lead plant that operated on the former Reichhold property during a time of little or no environmental regulations, in all likelihood, would have contributed to the lead contamination found on the site. Additionally, Reichhold discovered multiple battery casings during a soil removal action (summer 2004) near the former boiler house area. An early USMR map (1953) identified a battery breaker building on the USMR property. It is not unusual to find battery casings on lead manufacturing facilities because the batteries' cores are often used as raw materials. Mr. Walter Dittrich, a former Reichhold employee at the time of Reichhold's purchase of the Carteret facility from USMR, observed the presence of battery casings in the same area that the batteries were discovered in the recent soil removal action (Dittrich, 2006). Mr. Dittrich also observed an area for storage and use of malleable lead in the northwest corner of Building 401, and observed molten lead within the former lead manufacturing facility. Building 401 was constructed and used by USMR as part of its lead manufacturing operations. Based on Mr. Dittrich's observations, it is not surprising to find elevated concentrations of lead in adjacent soils

Based on the ACO, USMR was required to delineate soil contamination emanating from its site. As stated in Appendix A of the January 22, 1988 ACO between AMAX/USMR and NJDEP (NJDEP, 1988):

> "[AMAX/USMR shall] *Fully determine the nature, type and physical states of soil, surface water and ground water pollution at and/or emanating from the site.*
>
> *Fully determine the horizontal and vertical extent of pollution at and/or emanating from the site.*
>
> *Fully determine impact of the pollution on human health and the environment.*
>
> *Collect, present and discuss all data necessary to adequately support the development of a feasibility study and the selection of a remedial action alternative that will remediate the adverse impacts of the pollution on human health and the environment.*

Not only does AMAX/USMR's ACO require delineation and remediation of soil contamination emanating from the site, the NJDEP Technical Requirements also require that offsite areas be addressed. Pursuant to the RI requirements of the Technical Requirements for Site Remediation (N.J.A.C. 7:26E-4.1b):

> *The person responsible for conducting the remediation at the site shall determine if soil contamination has migrated off the property, at any depth, above the applicable unrestricted use standard.*

Based on USMR submittals to NJDEP to date, USMR has not attempted to delineate soil and/or slag contamination beyond its current property boundary. In addition, USMR has not fully evaluated the adverse impacts of these contaminants on the environment beyond its property boundary. This failure of USMR to delineate offsite contamination is an ongoing violation of the now 20-year-old ACO requirements.

SECTION 3

Surface Water and Sediment Impacts

USMR operations discharged metals to the Arthur Kill over several decades. The following sections summarize the USMR processes and operational procedures affecting surface water and sediments.

3.1 Historic Slag Occurrence and Stormwater Impacts

Historical descriptions of USMR operations provided to NJDEP indicated that significant volumes of slag were stockpiled on the site and along the banks of the Arthur Kill in piles more than 30 feet high (HydroQual, 1987). Aerial photographs of the site indicate that USMR stormwater likely was discharged directly from the slag piles to the Arthur Kill via runoff for many years. As shown in the aerial photograph from 1948, provided as Figure 3-1, stormwater runoff does not appear to be contained around the slag staging and disposal areas. In addition, several areas of stormwater runoff into the Arthur Kill are apparent along the length of the shoreline belonging to USMR. Figure 3-1 also apparently shows active direct surface water discharges from USMR operations to the intertidal zone along the Arthur Kill, including via the Tufts Point Marsh. Stormwater runoff from the slag piles could have contributed a significant amount of slag and dissolved/suspended metals to the Arthur Kill. Again, there is no information indicating that USMR disclosed these discharge locations to the NJDEP or attempted to control these discharges.

Besides these impacts to the Arthur Kill and the continuing potential impact of slag and metals-contaminated soil still exposed at the surface, the shoreline at and surrounding the USMR site, including approximately 80 percent of the former Reichhold site, is within the 100-year floodplain as depicted on the Federal Emergency Management Agency Firm Map (Figure 3-2). Of note, the former slag storage and disposal areas identified on the figures within this report are almost entirely within the 100-year flood zone.

3.2 USMR Process Water/Stormwater

USMR has a long record of discharges to surface water in violation of its NPDES permits and manufacturing process equipment problems, contributing to offsite releases of untreated wastewater containing metals, oil, and grease. Prior to the early 1970s and the inception of the NPDES program, USMR routinely discharged untreated wastewater to the Arthur Kill. USMR (1972) described a total of four wastewater discharge streams or outfalls that were in operation in the early 1970s that discharged directly to the Arthur Kill. In the Opinion of the U.S. District Court (September 1987) of the Civil Action suit between NJPIRG and Friends of the Earth vs. USMR, the Case Fact noted that USMR used enormous amounts of water for cooling and other operations, and that some of this water was discharged into the Arthur Kill via three USMR outfalls identified as DSN 001, 002, and 004. CH2M HILL attempted to identify these three outfalls with other known sources of information on wastewater discharge sources from USMR. Based on this comparison, it appears that a

discharge point consisting of an apparently un-named 21-inch-diameter overflow concrete pipe (identified by a comparison of aerial photographs, maps in Appendix I, and documents, as DSN 001) was located near the oil dock that discharged stormwater runoff from drains in the north end of the plant. This overflow pipe was located on the east side of the USMR facility, along the Arthur Kill. In addition, another un-named 18-inch-diameter outfall (apparently the same as DSN 002) was used for discharging non-contact cooling water from the oxygen-free plant heat exchangers and the nickel salts barometric condensers. Outfall 003, originally named Outfall 004, was a 48-inch-diameter pipe that was used to discharge wastewater from the wire furnace off-gas scrubber and slag granulation water (USMR, 1972). USMR may have had additional outfalls that were not cited under the NPDES program.

A USMR report submitted to the U.S. Environmental Protection Agency (EPA) in 1972, *Water-Borne Pollutants and Proposals for an Abatement Program*, describes USMR's historic practices of discharging contaminated process water to the Arthur Kill. The document described four work areas that contributed contaminants to plant wastewater:

- Wire Furnace Operations – Smelter Department
- Blast Furnace (Cupola) Slag Granulation Smelter Department
- Nickel Salts Evaporation – Copper Refinery
- Reverberatory Furnace Operations – Copper Refinery

These processes were described as creating 50 tons of dust per day from exhaust gases and using 32 million gallons per day (mgd) of water for process cooling (USMR, 1972). In that document, USMR describes that the failure to control water pollution was partially an economic decision:

> *Cleaning up the air, while undoubtedly salutary, contributes to problems we may encounter with regard to water-borne pollution and these problems are of a dual nature. Firstly and unfortunately, because of our concentrated efforts in successfully lessening air pollution, we were economically precluded from devoting as much effort as we might have to water pollution abatement. Secondly, ridding the exhaust gases of air pollutants increases the quantity of pollutants in the water discharge circuits since many pollutants are washed out of the gas stream with water.*

In describing the operation of its insulated wire furnace, USMR (1972) noted:

> *It is at this point in the system that liquid ammonia is initially introduced to neutralize the acid in the salt water spray effluent and probably is the cause of major contributions of metallic ions to water-borne contaminants. Thus, it is to be noted that the air pollution control system contributes to water-borne contaminants.*
>
> *…By necessity and for good air quality, the tubes in the precipitator are washed down with water to prevent excessive particle build up and to prevent electrical shorts in the unit which are monitored as spark rate. Again, an unfavorable measure of water contamination is produced by cleanup of air pollution devices.*

In describing operation of the cupola furnace slag granulation, USMR (1972) noted:

> *Once the slag and water enter the pit, the slag settles to the bottom and the water flows out two separate outlet lines located at each end of the pit. These outlets convey the slag granulating waters to the 42" and 48" lines to the Arthur Kill (Army Corps Engineer Discharge Serial Nos. 002 and 003).*
>
> *...The principal problem regarding possible water pollution is apparently caused by contact of the water with hot slag which contains some residual metals.*

A schematic detailing the layout of the process was provided by USMR (1972) and is shown in Figure 3-3. The schematic details how the process water was routed to a slag pit and then routed directly to the Arthur Kill.

Additional descriptions of process water impacts to the Arthur Kill are provided in a summary of the anode furnace (USMR, 1972):

> *The problem, as we see it, concerning possible water contamination of the anode furnace water is that muds, slurries, rain, etc. may wash the solids collected from the Anode Furnace scrubber to the discharge outlet to Arthur Kill. Here, the problem is unresolved.*
>
> *...It is manifest in seepages of scrubber water containing concentrations of particulate collected from metallurgical furnace stacks finding their way into drains which terminate in the Kill.*

USMR directly bypassed its storm/process water controls on more than one occasion, discharging untreated wastewater directly to the Arthur Kill (NJPIRG, 1986; NJDEP, 1987a). These discharge events were probably associated with storm events. This bypass of storm/process water controls occurred through direct discharges and releases from the wastewater holding pond. The wastewater holding pond was a component of the wastewater treatment system and had a capacity of approximately 8.3 million gallons. Although the pond was reportedly lined, it was of questionable integrity and was reported to have discharged untreated wastewater through seepages in the pond berms (Water, Waste & Land, 1987):

> *The storage pond was constructed in late 1976. A slope failure along the east berm in November 1976 required reconstruction of the berms west of their original location in early 1977...In addition to new areas of seepage along the east berm, seepage was observed on the exterior slopes of the south and west berms.*

The report also stated that a significant amount of sludge was present in the wastewater pond. The direct discharge to the Arthur Kill of metals-contaminated stormwater and process water occurred for several years, with no control of such discharges.

3.2.1 USMR National Pollutant Discharge Elimination System Permit Violations

USMR was issued their first NPDES permit on September 30, 1974, that became effective on November 29, 1974, authorizing it to discharge limited quantities of pollutants from its Carteret facility to the Arthur Kill through Outfalls 001 and 002, in accordance with the conditions set forth in the permit. As documented by the NJPIRG, between December 1977

and March 1986, USMR had 352 documented violations of their NPDES discharge limits for several regulated constituents including arsenic, zinc, copper, lead, silver, cadmium, and silver (Appendix J). In most cases, the discharged amounts were more than an order of magnitude greater than permit limits. As noted earlier, waste/process water discharges from USMR were not regulated for approximately 70 years, prior to 1974. Historical documentation shows that USMR had persistent difficulties with meeting NPDES discharge requirements, which led to a number of violations.

As detailed earlier, USMR used an enormous amount of water (greater than 30 mgd) for cooling and other metal operations during its period of operation. Excess portions of this water were discharged into one of three USMR outfalls, identified as DSN 001, 002, and 004. DSN 001 discharged fluids used in USMR's Nickel Salts Department. DSN 002 serviced the facility's stormwater treatment plant. Non-contact cooling water was discharged through DSN 004, later designated as 003. The locations of the outfalls were identified by HydroQual (1988b) and are provided in Appendix I.

The persistent violations also culminated in a lawsuit brought by NJPIRG. NJPIRG filed Civil Action 86-2041 against USMR on May 27, 1986 in the United States District Court for the District of New Jersey, claiming that USMR operated its Carteret facility between 1977 and 1986 in violation of its NPDES permit (NJPIRG, 1986). The suit alleged that USMR violated and continued to violate the Federal Water Pollution Control Act by failing to comply with the effluent limitations in its NPDES/New Jersey Pollutant Discharge Elimination System (NJPDES) permit number NJ0001899.

It was reported in the NJPIRG suit that between 1977 and 1986, USMR had 494 separate violations of the effluent limitations in its 1974 and 1986 permits for constituents that included lead, zinc, copper, cadmium, oil and grease, total suspended solids, and pH. Some of these violations resulted in increased discharges of metals by a factor of more than 100 times above the permitted level. For example, the permitted discharge limit for zinc in 1986 was 1.26 kilograms per day (kg/day); however, USMR exceeded this discharge limit by discharging 138.75 kg/day in February 1986. In addition, the Discharge Monitoring Report (DMR) for the month of April 1979 indicated an average oil and grease discharge of 73.7 kg/day, which was over an order of magnitude greater than the permitted level of 4.30 kg/day. This resulted in a total average loading of oil and grease to the Arthur Kill from DSN 002 for the month at 2,211 kg. In the month of February 1980, the average concentration of lead discharged to the Arthur Kill was 3.18 kg/day, which was also well above the permitted average of 0.45 kg/day. This resulted in a total discharge of 89 kg of lead to the Arthur Kill for the reported month from DSN 002 alone. A summary of these violations is presented in Table 3-1. In addition, a chronological listing of NPDES permit violations at the Carteret facility is provided in Appendix J.

TABLE 3-1
USMR NPDES Violations (1974 through 1986)

Parameter	Total Number of Violations
Lead	35
Cadmium	71
Zinc	135
Copper	77
Silver	1
Oil & Grease	31
Nitrogen	21
Turbidity	1
Temperature	42
pH	28
Unauthorized Bypass	6
Total Suspended Solids	46
Total Violations	**494**

Not only were there violations to the effluent limits during USMR's monitoring activities, but there were several instances where USMR reported that it bypassed its storm/process water treatment system and discharged untreated wastewater directly into the Arthur Kill in violation of its 1974 permit (NJPIRG, 1986). This occurred several times, including a period of 6 days (from November 27 through December 2, 1985). USMR again bypassed its storm/process water treatment system on November 20-21 and December 15-23, 1986; and January 2-3 and January 10, 1987, directly discharging untreated wastewater to the Arthur Kill (NJDEP, 1987a).

EPA sent a letter to USMR on September 25, 1979 regarding effluent limitation violations, stating (emphasis added):

> *Thus, not only has there been a steady need to discharge excess process water – storm water via outfall 002 into the Arthur Kill since May 1978 contrary to design expectations, but also* ***the discharges have resulted in relatively significant violations of the effluent limitations contained in Condition 10 or your permit, particularly those for TSS, oil and grease, copper and zinc.***
>
> *EPA's official permit holder files contain copies of numerous letters sent to U.S. Metals and Refining Company which cite deficiencies discovered as a result of compliance inspections performed by personnel or the U.S. EPA or review of discharge monitoring reports. While U.S. Metals and Refining Company has replied to these letters,* ***it is clear that significant violations of effluent limitations as well as deficiencies in proper sampling procedures have occurred since the date of permit issuance.***

> *It is this Agency's opinion that U.S. Metals and Refining Company has not been keeping the U.S. Environmental Protection Agency sufficiently informed of the causes of its effluent limitation violations and the actions it is taking or is considering taking to correct these deficiencies.*

The main purpose of this letter was to obtain information regarding why USMR was not able to meet its NPDES obligations, and why it had recurring NPDES violations over a 15-month period from May 1978-July 1979. As indicated by the discharge records, USMR continued to violate its NPDES permit effluent limitations well after issuance of this letter.

In defense of its actions to claims made in the NJPIRG lawsuit, USMR argued that it should be accorded credit for those times when it achieved discharge concentrations below the permitted levels. In other words, the discharge concentrations below the permitted discharge limits should be offset against those discharge concentrations occurring above the permitted limit. The Honorable Maryanne Trump Barry of the United States District Court for the District of New Jersey rejected this request (U.S. District Court, 1987). In addition, USMR stated that it underreported discharge violations because there was not enough space on the monitoring report forms. As stated in the Decision (U.S. District Court, 1987) (emphasis added):

> *The primary thrust of defendant's argument is that new government-supplied DMR forms provided space to report only one excursion per month. Thus, defendant's argument goes, it assumed that its permit obligations had been altered.* ***Defendant's assumption borders on the ludicrous.***

The judge indicated that there could be no doubt as to USMR's liability for the permit violations.

The civil action was resolved with consent decrees being filed by the U.S. District Court on June 23, 1986. The consent decrees required USMR to conduct further monitoring of surface water discharges and pay fines of more than $1 million for the violations committed.

These consent decrees did not end USMR's NPDES violations. After execution of the consent decree, USMR notified NJPIRG in 1986 and 1987 of several violations of discharge limits and requirements of the consent decree. These violations resulted in additional fines that totaled $15,000.

No indication was found that USMR discussed these repeated NPDES violations in any ISRA reports summarizing the environmental investigations after closure of the active facility. In its description of the wastewater processes provided to the NJDEP in the 1988 RI report, USMR did not provide any information regarding the discharge violations summarized above. Information provided in the 1988 RI report only summarized discharge concentrations averaged over an entire year. Therefore, data regarding the violations were not presented. Discharge issues affecting the Arthur Kill from the events described above, including impacts to sediments, were not addressed in the USMR environmental reports.

3.3 Sediments

The previous section described the multiple NPDES permit violations committed by USMR over the years. There is the potential that the large volumes of metals discharged to the Arthur Kill, including lead, copper, cadmium, zinc, arsenic, nickel and chromium, accumulated in sediments either directly as slag entrained in stormwater/wastewater or indirectly as geochemical precipitation.

Even though USMR's ACO required delineation of contaminants emanating from the site, no information has been found that USMR collected sediment or surface water samples from the Arthur Kill. In addition, USMR stockpiled slag along the banks of the Arthur Kill with no apparent stormwater controls, as evidenced by historical aerial and recent photos referred to in the previous section. Documents submitted to the NJDEP by USMR described the slag as being fine-grained (HydroQual, 1987). In addition, a significant amount of zinc dust was reported to be dumped at the site (HydroQual, 1987). Both of these media would be readably transported by surface water runoff or wind.

According to the 1988 ACO (NJDEP, 1988), USMR was required to:

> *Fully determine the horizontal and vertical extent of pollution at and/or emanating from the site.*
>
> *Fully determine the impact of pollution on human health and the environment.*
>
> *Fully determine migration paths of pollutants through air, soil, groundwater, surface water and sediment.*
>
> *Specify number and type of samples required to accurately determine the horizontal and vertical extent of surface water and sediment pollution at and/or emanating from the site.*

Sediments may have been affected by improper discharges of untreated wastewater to surface water, surface water from slag piles, and deposition from facility air emissions. USMR referenced the potential impact to sediments in a document prepared for USMR analyzing groundwater flow impacts to the Arthur Kill (Environmental Medicine, Inc., 1987). As stated in the Environmental Medicine document:

> *Contaminants migrating into the Arthur Kill are distributed among three potential exposure media: water, sediments, and biota.*
>
> *Pathways for exposure of aquatic organisms to metals include: directly from the water column to the organism, from sediments to the organisms, and from previously exposed food organisms to predators.*
>
> *...Biota with life strategies that expose them to sediments (benthic organisms) are more likely to encounter the higher concentrations of metals present in the sediment.*

Based on the description provided by Environmental Medicine, the ecological impacts of USMR's operations to the Arthur Kill are not understood.

On June 25, 2007, NJDEP filed a civil action in the Superior Court of New Jersey against USMR for natural resource damages (NJDEP, 2007). NJDEP is seeking costs and damages from USMR for any natural resource that has been injured by the discharge of pollutants or hazardous materials from the USMR site. NJDEP is also requiring USMR to perform a baseline ecological assessment of sediments and surface water at the site. However, a review of the complaint indicates that NJDEP may not realize the historical extent of the former USMR facility and the manufacturing period. The complaint indicated a period of operation beginning in 1920, whereas the smelter was actually first operated around 1902. In addition, the complaint indicated the total site acreage to be around 180 acres. If the property of the former USMR lead plant is considered, the former USMR facility totaled more than 200 acres. If other areas affected by USMR operations are also considered, the total area of impacted soils, sediments and water totals several hundred more acres in Carteret, New Jersey; Staten Island, New York; and the Arthur Kill in between.

To document recent surface conditions of the area near and on the former USMR facility, CH2M HILL took photographs of the area north of the USMR facility and along the western, southern, and eastern boundaries of the former Reichhold site (Appendix C). These photographs, whose locations were overlaid on a 2008 aerial photograph (Figure 3-4) and a 1954 aerial photograph (Figure 3-5), show widespread occurrence of exposed slag and slag-like material in surface soils and in sediments along the Arthur Kill, on the former Reichhold site, around the former USMR facility, and within the Veterans Pier and Carteret Waterfront Park, located immediately north of the USMR facility. The exposed slag varies in color from dark black to light brown, in density, and in size from sand sized grains to pieces several feet in diameter. Additionally, CH2M HILL collected samples of the exposed, granular slag and other metallic-looking slag-like material from selected locations. These sample locations are identified on the photographic log in Appendix C.

SECTION 4

Air Emissions

The following sections summarize impacts from the deposition of lead and other contaminants from USMR process emissions sources. The results from air monitoring and modeling studies are presented that provide estimates of the air emissions from the USMR facility. Additional information is provided documenting USMR's violations of air permit regulations and the detrimental effects of USMR's emissions on the surrounding region.

In 1982, the USEPA sponsored a study to assist the NJDEP in developing a consent decree to reduce emissions from the secondary copper smelter at the USMR facility. This study, conducted by PEDCo Environmental, Inc., found that based on tests conducted by USMR in March 1982, the cupola was emitting hydrocarbons from 19-212 pounds per hour (lbs/hr). These emissions included benzene, whose emission rate varied from 4-73 lbs/hr. Similarly, the PEDCo study reported that a July 1981 NJDEP-approved study conducted by Rutgers, the State University of New Jersey, indicated VOC emissions ranged between 43.4-197.3 lbs/hr and benzene emissions up to 67 lbs/hr.

4.1 Deposition from Stack and Fugitive Dust Emissions

USMR documents describe a metal smelting process that emitted a significant amount of particles from stacks and fugitive emissions sources over an extended period (see Figures 1-2, 1-3, 1-4, 2-2 and 3-1). The smelter operated for more than 80 years (from about 1902 to 1986) and for the first several decades of operation, there were likely no regulatory requirements for emission controls and it is probable that there were no controls in place. Based on the number of violations and equipment malfunctions as documented in this report, even after emissions controls were installed, there were numerous occasions when the controls did not function at all, or functioned well below their design capacity.

In response to public concern over air quality near the USMR site, the NJDEP and USMR signed several consent orders between 1968 and 1994. These consent orders imposed partial controls on the smelting process and associated emissions, but no controls on the fugitive emissions that were not associated with the stack (Landrigan, 1989).

The two contaminants of greatest concern from the USMR smelter emissions were dioxin and lead (Landrigan, 1989). As part of the EPA's National Dioxin Study, samples were collected from USMR emissions. The results of the study were released in 1987. In analyzing the samples from USMR, laboratory equipment was "overwhelmed" by dioxin concentrations that were one- to four orders of magnitude greater than any other source investigated. Over the 25 years for which the facility operated as a (secondary) metals recovery facility, it released approximately 20 kg of 2,3,7,8- tetrachlorodibenzodioxin (2,3,7,8-TCDD) (Landrigan, 1989).

NJDEP listed the USMR smelter in its 1985 lead State Implementation Plan (SIP) as the source of 50.1 tons of annual lead emissions from the stacks and an additional 36 tons per year from fugitive emissions. These emissions were the only reason the State was unable to

meet its SIP for ambient air quality for lead (Landrigan, 1989). The SIP effectively implicated USMR for the high lead concentrations found in surface soils in downwind areas on Staten Island, like the Rossville Cemetery. In 1982, when emissions controls were in place, combined lead emissions from the USMR smelters, cupola, reverbatory- and Dorr furnaces and pug mills was up to approximately 20 lbs/hour (NJDEP, 1985).

Besides the long list of emissions-related Notices of Violations (NOVs) received by USMR (Section 4.2.3) and emissions litigation issues, USMR also admitted to having a significant number of operational problems with the air emission control equipment. USMR documented some of these problems in its report to EPA (USMR, 1972):

> *The emission rate for particulates out of the Cottrell precipitator is approximately 3 to 5 pounds per hour (lbs./hr.) when all of the control apparatus is functioning properly. When operating difficulties are encountered (and they are frequent) with any of the various units in the emission control apparatus, emission rates can exceed 100 lbs./hr.*

Other sources of metals deposition would have resulted from wind-blown slag and zinc dust. HydroQual described the slag material dumped at the site as having a fine-grained consistency, with the potential to become wind borne (HydroQual, 1991):

> *Air monitoring since 1985 has shown a decrease in particulate levels on the plant site perimeter; however, the potential exists for air borne dust and particulates containing heavy metals to be transported both on and off the site.*

Based on the amount of slag materials stockpiled on the site for decades, airborne dust from these areas may also have been a significant source of metals contamination to the surrounding area.

4.2 USMR Air Emission Impacts

The following sections summarize impacts related to USMR's long history of air emission.

4.2.1 Delay of State Implementation Plan

On December 12, 1985, EPA announced that it was delaying final approval of the New Jersey SIP for the Borough of Carteret for the attainment and maintenance of national ambient air quality standards for lead. The reason for the delay in implementing the SIP was that USMR was not able to attain the national ambient air quality standard for lead. EPA concluded that USMR's lead emission modeling was inaccurate, and USMR continued to experience violations for exceeding air quality emissions. EPA added:

> *However, it is now apparent that this demonstration of attainment was inaccurate and that additional control measures are needed at this location. This is because, despite the implementation of all control measures contained in the New Jersey Order, violations continue to be monitored. Therefore, EPA's proposed approval of the SIP control strategy with regard to USMR has been shown to be based on an apparently erroneous demonstration of attainment… However, if after reasonable time the State fails to provide the expected control plan, EPA will propose a federal strategy."* (EPA, 1985)

EPA's concerns were justified, based on the impact of the emissions from USMR on the surrounding region.

4.2.2 Impacts to Arthur Kill and New York

Prior to the construction of the 400-foot cupola stack in 1948, USMR emission sources were located closer to the ground, creating an apparent nuisance to the surrounding community and portions of Staten Island. For example, the State of New York reported that "significant air pollution incidents were traced back to USMR in a 1932 report submitted to the New York State Health Commissioner" (Landrigan, 1986). Earlier in 1913, New York Assistant Attorney General Fiorello LaGuardia attempted to obtain relief for citizens on Staten Island from air pollution from USMR (Landrigan, 1989). Details reported in Lyndon (1984) from 1934 included the following excerpts from the State Commissioner of Health:

> *...when certain of these smoke, gases, fumes, and vapors descend and pass over the Arthur Kill and onto Staten Island a public nuisance and a menace to health is created in Richmond County by reason of the offensive, irritating, poisonous or otherwise objectionable and injurious nature of said smoke, gases, fumes and vapors.*

> *...The immense volumes of smoke and fumes emitted practically continuously from the tall stack of the U.S. Metals Refining Company (No. 18)...Generally the smoke and fumes from this stack were observed to be traveling for great distances with the wind, as far as 4 miles from the stack, and under the prevailing wind directions were usually drifting over and onto Staten Island.*

Air emissions were still considered a health hazard by the State of New York, leading up to the cessation of the operations at the USMR facility. A report provided by the NYSDEC's Staten Island Air Quality Study included the following observations (Lyndon, 1984):

> *The field observations performed by DEC personnel during the period May through September 1982 point to U.S. Metals as the source of burnt odors in S.I.* [Staten Island]*...Smoke observations made during these incidents strengthen this conclusion.*

The State of New York filed a lawsuit on March 13, 1983 against USMR for impacts to Staten Island because of air emissions from the USMR facility in Carteret. The concerns cited by the State resulted from environmental exposure of Staten Island residents to 'harmful quantities of pollutants in the ambient air" (State of New York, 1983). The State was successful in obtaining an Order from the United States District Court, District of New Jersey (U.S. District Court, 1986) on January 13, 1986 for the purpose of shutting down USMR's smelting operations for a period of 10 days. As stated in the Order:

> *...and it appearing that immediate and irreparable injury will result in the form of harm to public health and welfare should defendants USMR and AMAX resume operations at their Carteret plant...*

The resulting Consent Judgment ordered USMR to cease operations of the cupola furnace, arc furnace, and converter by October 21, 1986 (State of New York, 1986). USMR also agreed to pay $75,000 to create a fund for the State of New York for the purpose of remediating soil contaminated with lead around the affected area of Staten Island.

In March 1986, the City of New York wrote to the USEPA Administrator regarding its concern over the "extraordinarily high" levels of dioxins and dibenzofurans emitted by the USMR facility in previous years; the USEPA had apparently stated that the emissions of these toxic substances had "their most serious impact on residents of Staten Island". A letter from the State of New York Attorney General's Office (March 3, 1986) to the USEPA Administrator reiterated the very high emissions of dioxins and furans from USMR operations and apparent flaws in USEPA's interpretation and enforcement of air quality standards. This letter points out that the USEPA knew about "flawed" dioxin emissions test results; the results were flawed because the dioxin concentrations in emissions were so high that they contaminated analytical equipment and "rendered test results invalid".

4.2.3 Other Regional Impacts

4.2.3.1 Air Quality Impacts to County of Middlesex

The environmental problems created by USMR affected not only the former Reichhold site but also the regional area. The significant number of air quality violations issued by the County of Middlesex illustrated these problems. The Middlesex County Department of Health was so concerned about the operation of USMR that in late 1985 and in 1986, they made frequent visits to USMR. Most of these visits were prompted by numerous citizen complaints in towns to the west of USMR including Port Reading and Woodbridge. This demonstrates that the wind was carrying the air emissions from USMR to the west over the Reichhold property and to the towns beyond.

At times, the Middlesex County Health Department made up to four visits per week to USMR in response to citizen complaints or on its own initiative. This demonstrated an extraordinary level of concern for USMR's operations. This concern from USMR operations was in a county with several other industries that were not being visited while the inspectors were visiting USMR. In most cases, these visits resulted in one or more NOVs to USMR. In 1986 alone, Middlesex County Department of Health, issued 134 NOVs to USMR for air quality violations. The County had also issued NOVs in 1984. These violations included a number of items. Examples of the listed violations included:

> *"Excessive opacity from Smelter #1 and associated baghouse caused by damaged bags", "baghouse not functioning properly while Smelter #1 in use", and "operating equipment covered under NJDEP/Bureau of Air Pollution Control permit to construct (BAPC P/CT)# 071581 with baghouse bag failure causing excessive fugitive emissions."*

For example, as documented in Pearson (2007), "Mr. Carl Ochs, NJDEP Senior Environmental Specialist states in an inspection report of USMR dated June 10, 1982:

> *"Arrived at observation point, observed heavy white fugitive emissions (100% opacity) from the smelter building, blowing across the river toward Staten Island; also heavy plume from the 240 ft. cupola stack. (White, opacity estimated at 40%, but poor background prevented accurate call)".*
>
> *"CONCLUSIONS: The observations of fugitive emissions on 6-7-82, in my opinion, were not unusual. I have been observing and reporting these problems for at least three years now".*

The many failures of the baghouses led to significant fugitive emissions; as documented throughout this report, these emissions contained significant amounts of metals, hydrocarbons, and even highly toxic and hazardous chemicals like dioxins and furans, due to incomplete combustion.

The series of 134 NOVs issued by the Middlesex County Health Department to USMR over a period of nine months from February to November 1986 shows that even when the smelter had installed air pollution control equipment and was operating with all of this equipment, violations of air pollution standards at the USMR facility was occurring frequently.

During the decades in which the USMR site operated its smelter prior to air pollution regulations and inspections, equipment failures and malfunctioning equipment would have released even greater quantities of fugitive emissions. These emissions, over the decades of operations, impacted the former Reichhold site prior to and during Reichhold's ownership of the site, until 1986, and also the surrounding region, including Carteret, other parts of Middlesex County, the Arthur Kill, and Staten Island.

These emissions affected not only the local and regional environment, but also the residents of Carteret and Middlesex County, as evidenced by numerous public complaints of strong, acrid, unpleasant odors, and air opacity from the stack emissions.

4.2.3.2 Failure to Operate Under Required Permits

During this same period of emission violations and legal actions, USMR was also assessed a civil administrative penalty by NJDEP for failure to obtain the required permits to construct, alter, or operate equipment (NJDEP, 1987b). The equipment included a boiler, a 20,000-gallon fuel oil storage tank, and a 2,000-gallon gasoline storage tank.

The repeated air emission violations, legal actions, and equipment violations illustrate the difficulty USMR had with complying with a variety of applicable regulations even near the end of its operations in the mid-1980s.

SECTION 5
Conclusions

This report summarizes the local and regional environmental impacts from the USMR operations on the former Reichhold site as well as the surrounding community. A review of historical documents reveals that the USMR facility had significant difficulty maintaining compliance with a variety of air and surface water regulations. Routine operations early on and repeated violations of applicable environmental regulations later in its operational history resulted in widespread regional deposition of metals as far east as Staten Island, New York. As summarized in this report, USMR cites economic business decisions as one of the main reasons for not attaining or even attempting to control the environmental pollution.

The following conclusions can be drawn from the information presented in this report:

- Our technical evaluation of available information indicates Reichhold remedial obligations, under ISRA, or otherwise, should not include metals impacts in environmental media.
- The use of metals was not a significant part of operations at the former Reichhold site. Reichhold owned its former site from 1960 to 1986, whereas USMR's environmental impacts began affecting the area from 1902 when USMR first operated the copper smelter and continued through the USMR facility closing in 1986.
- By far, the most prevalent sources of metals on and near the former Reichhold site are from USMR facility operations.
- Slag wastes containing metals were either deposited on the former Reichhold property by USMR prior to Reichhold's ownership and operation; or metals migrated to the former Reichhold property from adjacent USMR operations via several media before, during, and after Reichhold's tenure, including as a consequence of USMR's NJDEP-approved groundwater remediation for chlorobenzene.
- The discharges of metals to the property from the USMR operations took place for over 80 years prior to, and during Reichhold ownership of the site.
- Environmental impacts to the surrounding properties and the Arthur Kill remain unaddressed by USMR. Visual observations and photographs of the southwestern portion of the USMR property, taken from the southeastern portion of the former Reichhold property in May 2007 and again in April through June 2008 indicate that slag materials are still exposed on the ground surface of the USMR property and the nearby sediments of the Arthur Kill.
- Slag and other waste composed of various metals in concentrations greater than NJDEP cleanup standards were used to fill in low-lying wetland areas as a waste disposal practice and in order to enlarge the land area for operations on the USMR facility and the former USMR lead plant which was located on the former Reichhold property. This placement of slag has contaminated both soil and groundwater. Impacts above NJDEP

criteria for metals at the site still exist from slag disposal activities. It is very likely that sediments of the Arthur Kill were also contaminated with slag containing metals; however, contrary to the requirements of the Technical Requirements for Site Remediation (N.J.A.C. 7:26E-3.11) and the terms of its ACO with the NJDEP, no sampling of this media has been conducted by USMR to date.

- The process of pumping chlorobenzene and metals-contaminated groundwater from the USMR property, removing the chlorobenzene, and spray irrigating the water back onto the former Reichhold property has very likely redeposited metals, further spreading and adding to the groundwater metals contamination on the former Reichhold property.
- There is no indication, from its reports submitted to NJDEP, that USMR has delineated metals contamination occurring in soil, sediment, or groundwater beyond its current property boundary including lands it previously owned and operated to the west of its current property boundary where USMR formerly operated a lead smelting plant and used some of the land for slag and fill materials disposal.
- Based on available data, relatively high concentrations of chlorinated organic compounds may still be present in the groundwater beneath the current USMR property, which act as a continuing source for organic groundwater contamination at the former Reichhold property.
- Emissions from the USMR facility caused significant deposition of lead and other regulated metals on surrounding properties and across the Arthur Kill in Staten Island, New York. Negative environmental impacts were measured through historical and regulatory documentation as well as air emissions monitoring and modeling sampling and noted by eyewitness accounts.
- Significant releases of metals in surface water discharged to the Arthur Kill from USMR occurred over decades, as acknowledged by USMR in the monthly DMRs and other documents that it prepared.
-
- Significant amounts of regulated metals also were discharged through wastewater by repeated NJPDES permit violations over a number of years.

Timeline of Significant Events

Date	Event
Fall 1901	Ground broken for USMR's copper refinery, formerly known as DeLamar's Refining Works
March 1902	Copper smelting operations begin at USMR facility
1931	Operations begin at USMR lead plant on former Reichhold property
1948	400 foot high cupola stack operational at USMR smelter facility
1951	USMR lead plant on former Reichhold property ceases operations
1960	USMR sale of 45 acre property to Reichhold
September 30, 1974	EPA issues USMR a NPDES permit for process wastewater and stormwater discharges
1974-1986	Multiple (i.e. nearly 500) NPDES permit violations by USMR
1977	Effluent guidelines of NPDES permit are modified and remain in effect until 7/1/1986
1977	Reservoir put online to achieve zero release from NJPDES surface water discharge at DNS 002
November 1979	Technical expiration of USMR NPDES permit from EPA
March 13, 1983	State of New York files a citizens' suit against USMR for emitting harmful quantities of pollutants into the ambient air
March 16, 1983	NJDEP issued ACO to USMR to control emissions from cupola stack and fugitive air emissions
April 1985	EPA issues a draft renewal NPDES permit which would have required zero surface water discharge by 4/22/1987
October 1985	USMR announces plans to phase out smelting operations
November 27, 1985 to December 2, 1985	USMR bypasses onsite wastewater treatment system, discharging untreated wastewater and stormwater into the Arthur Kill
December 12, 1985	EPA delays final approval of New Jersey SIP because of USMR's failure to comply with lead concentrations in air emissions
February 1986	USMR restarts smelting and refining operations in order to process remaining inventories
March 22, 1986	NJDEP issues USMR a new NPDES permit requiring zero discharge as of 7/1/1986; USMR receives a temporary stay of the permit until 7/14/1986
May 26, 1986	NJPIRG files Civil Action 86-2041 against USMR for repeated violations of the effluent limits in its NPDES permit
May 27, 1986	Last day of 2.5 months of unpermitted surface water discharges from DSN 002 resulting from USMR water main break
June 1986	Reichhold sells southern property parcel to Bakelite Thermoset Limited, Inc. (BTL)

Date	Event
June 20, 1986	NJPIRG and USMR enter into a Consent Decree against further violations
June 30, 1986	Consent Judgment, State of New York vs. United States Metals Refining (USMR) Company and AMAX, Inc.; $75,000 payment to State of New York to remediate soils contaminated with lead across the Arthur Kill on Staten Island
July 14, 1986	NJDEP modifies the NPDES permit for discharges from USMR operations
October 21, 1986	USMR ceases smelting operations
November 1986 to February 1987	Multiple bypasses of wastewater treatment system by USMR and direct discharge to the Arthur Kill
March 1987	Reichhold sells northern parcel to Staflex Specialty Esters, Inc. (Staflex)
July 9, 1987	NJDEP Administrative Order and notice of Civil Administrative Penalty Assessment - USMR operated the following equipment without a permit: 1) Cleaver Brooks boiler, 2) 20,000-gallon #2 fuel oil storage tank, and 3) 2,000-gallon gasoline storage with vapor controls; $1,200 penalty assessed
September 22, 1987	NJPIRG files citizens' suit against USMR for repeated violations to the effluent limits in its NPDES permit
January 22, 1988	NJDEP Division of Hazardous Waste Management signs ACO with AMAX/USMR
December 12, 1989	New Consent Decree replaces NJPIRG June 1986 Consent Decree with USMR
April 24, 1992	NJDEP issues ACO per transfer of ownership, as defined under ECRA
March 16, 2006	NJDEP issues USMR a letter indicating USMR is obligated to investigate the extent of groundwater metals contamination on the former Reichhold property
May 15, 2007	Site visit and photographic log showing existing surface occurrence of slag materials
June 25, 2007	NJDEP files a civil action against USMR for natural resource damages (NRD)
April 2008 to June 2008	Site visits and photographic logs showing slag materials are still exposed on the ground surface of the USMR property and the nearby sediments of the Arthur Kill

SECTION 7
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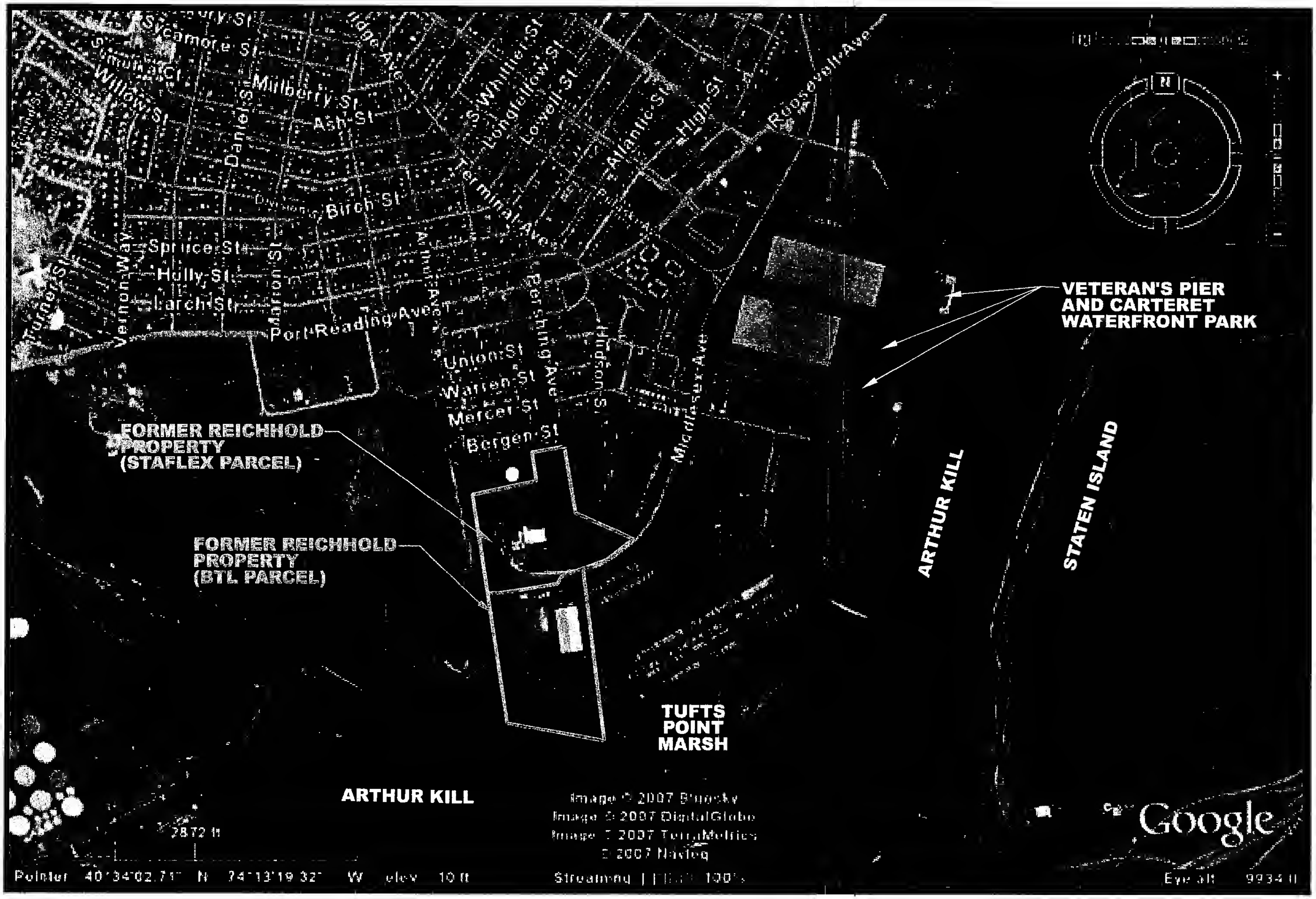
USMR. 1972. *Report of United States Metals Refining Company, Water-Borne Pollutants and Proposals for an Abatement Program.* USMR 007195-007254. June 2.

Water, Waste & Land, Inc. 1987. Letter: USMR Carteret Process Water Storage Facility. April 14.

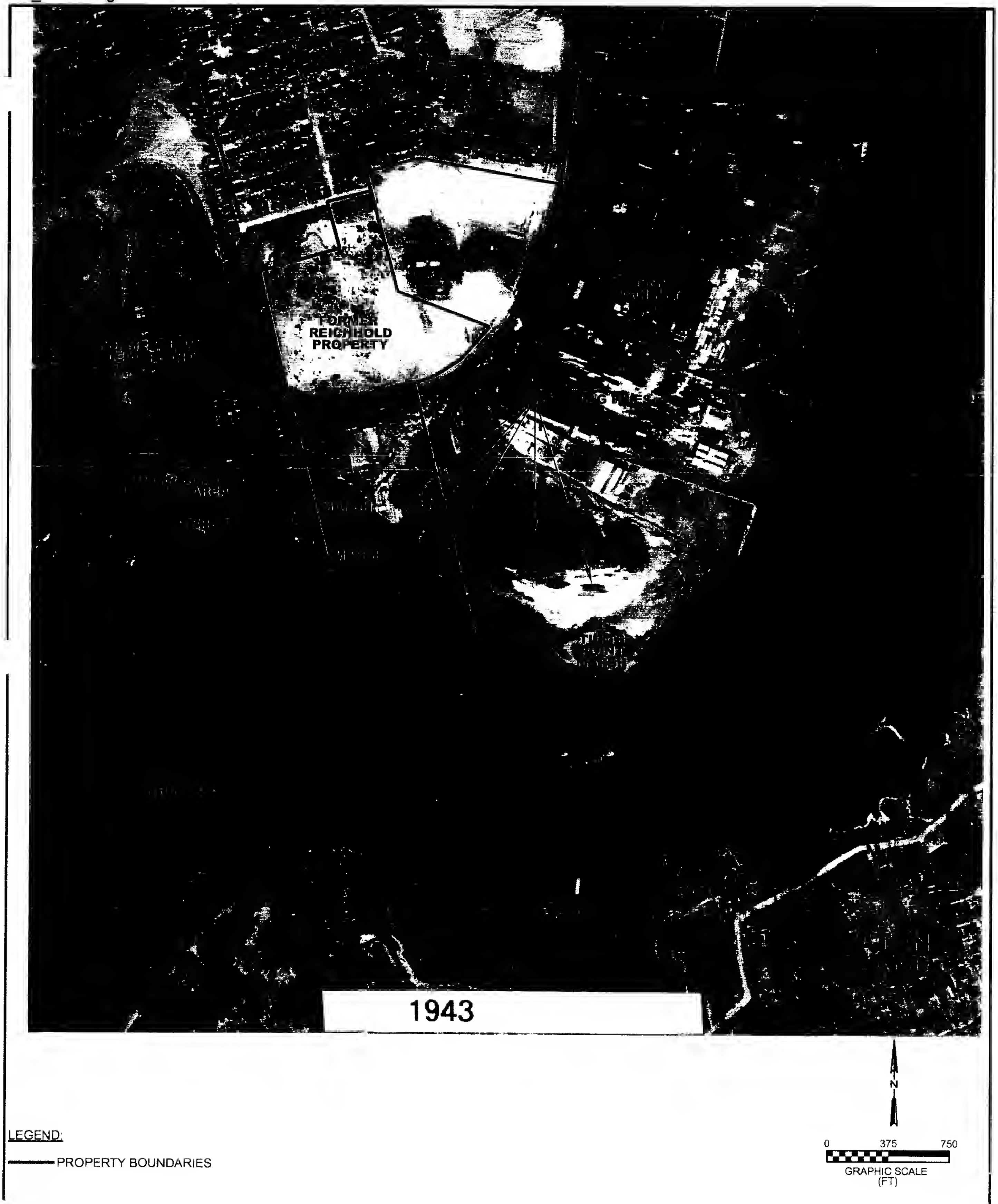
f11_33820



NOTE: PROPERTY BOUNDARIES ARE APPROXIMATE

Figure 1-1
Site Location Map
CH2MHILL

f52_338202.dgn



LEGEND:

PROPERTY BOUNDARIES

NOTES:
VERTICAL DATUM = N.G.V.D. 1929
FORMER REICHHOLD SITE PROPERTY BOUNDARIES ARE BASED ON TOPOGRAPHIC SURVEY DATA FROM MAY 2008; THE SOUTHERN PROPERTY BOUNDARY OF THE FORMER REICHHOLD SITE REPRESENTS THE US GOVERNMENT BULKHEAD LINE ADOPTED BY THE RIPARIAN COMMISSION ON JANUARY 9, 1912. USMR PROPERTY BOUNDARIES ARE APPROXIMATE.

Figure 1-2
Location of Former USMR Facility 1943 Aerial Photograph

CH2MHILL

f54_33820

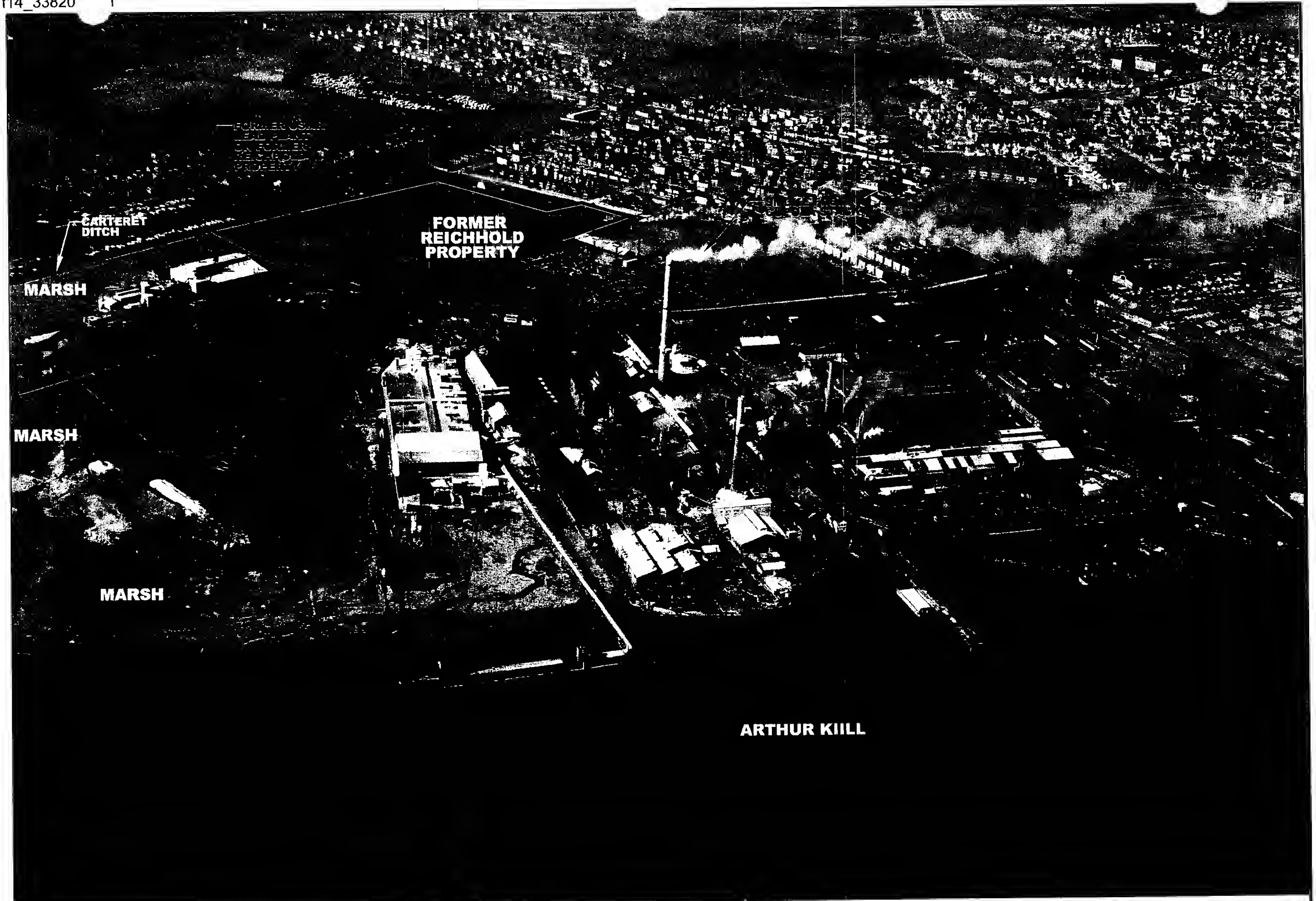
LEGEND

PROPERTY BOUNDARIES ARE APPROXIMATE

Figure 1-3
USMR Facility
1948 Aerial Photograph
Southwest Perspective

CH2MHILL

f14_33820



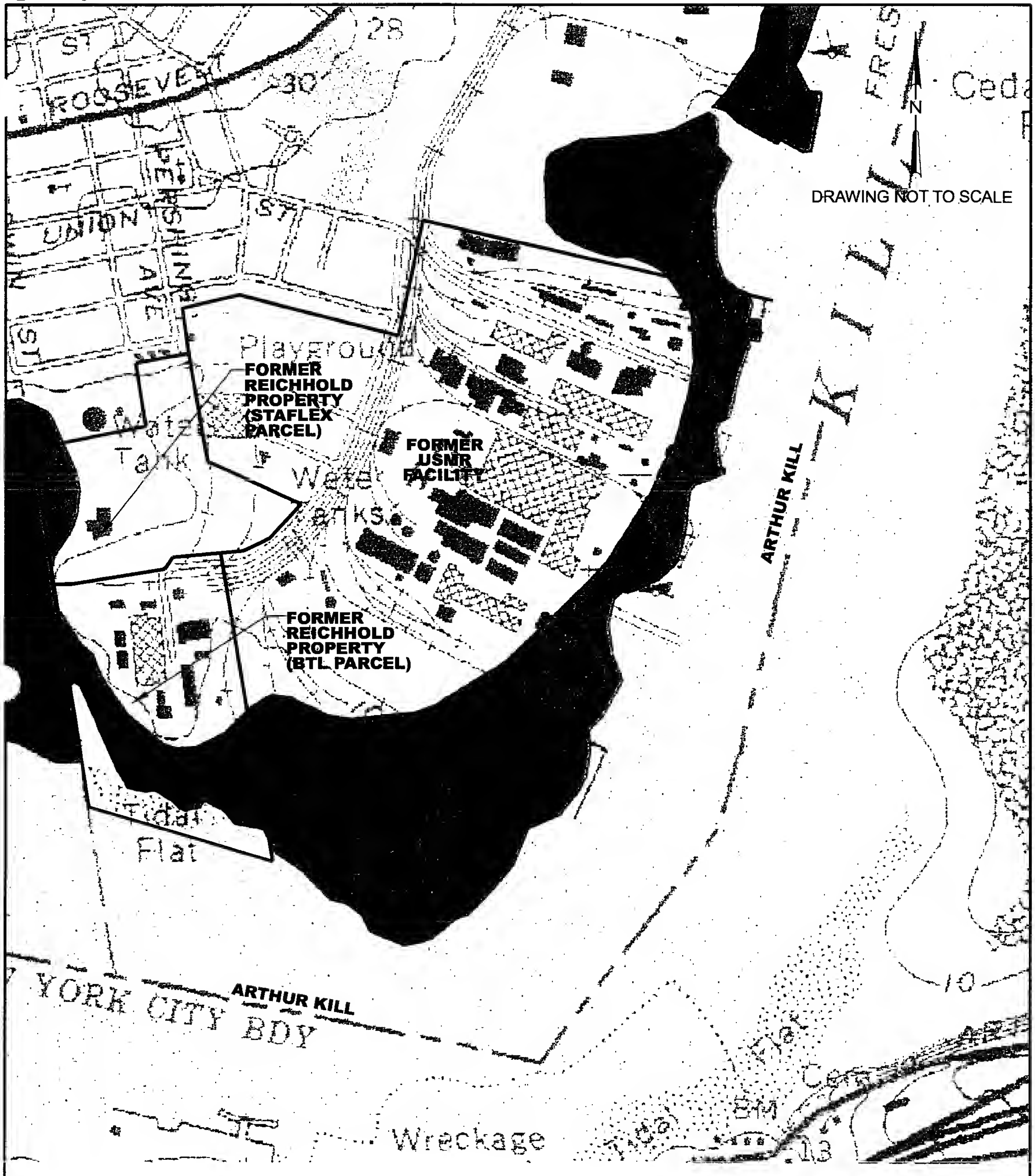
LEGEND

—— PROPERTY BOUNDARIES ARE APPROXIMATE

Figure 1-4
1948 Aerial Photograph East Perspective

CH2MHILL

f57_338202.dgn



HISTORIC FILL

NOTES:

1. PROPERTY BOUNDARIES ARE APPROXIMATE
2. SOURCE: HISTORIC FILL OF THE ARTHUR KILL QUADRANGLE 2004, LAND USE MANAGEMENT, NEW JERSEY GEOLOGICAL SURVEY, NJDEP, HISTORIC FILL MAP HFM-63

Figure 2-1
Historic Fill Areas Within and Surrounding USMR Property as of January 2008

CH2MHILL

f55_338202.dgn

N

0 375 750

GRAPHIC SCALE (FT)

LEGEND:

PROPERTY BOUNDARIES

NOTES:

VERTICAL DATUM = N.G.V.D. 1929

FORMER REICHHOLD SITE PROPERTY BOUNDARIES ARE BASED ON TOPOGRAPHIC SURVEY DATA FROM MAY 2008; THE SOUTHERN PROPERTY BOUNDARY OF THE FORMER REICHHOLD SITE REPRESENTS THE US GOVERNMENT BULKHEAD LINE ADOPTED BY THE RIPARIAN COMMISSION ON JANUARY 9, 1912. USMR PROPERTY BOUNDARIES ARE APPROXIMATE.

Figure 2-2

Location of Former USMR Facility
1954 Aerial Photograph

CH2MHILL

f50_338202.dgn

LEGEND

FORMER REICHHOLD PROPERTY BOUNDARY FROM JUNE 2008 SITE SURVEY

MAXIMUM EXTENT OF THE 500 YEAR FLOOD PLAIN FROM JUNE 2008 SITE SURVEY

STATE TIDELANDS CLAIM LINE FROM NJDEP DIVISION OF COASTAL RESOURCES, ATLAS SHEET NO. 623-2118

EDGE OF WATER - APPROXIMATE HIGH TIDE FROM MAY 2008 E-005 DRAWING

10-FOOT CONTOUR FROM JUNE 2008 SITE SURVEY

0 100 200 300
SCALE IN FEET

Figure 2-3
Former Reichhold Carteret Property
1963 Aerial Photograph

CH2MHILL

f51_338202.dgn

LEGEND

FORMER REICHHOLD PROPERTY BOUNDARY FROM JUNE 2008 SITE SURVEY

MAXIMUM EXTENT OF THE 500 YEAR FLOOD PLAIN FROM JUNE 2008 SITE SURVEY

STATE TIDELANDS CLAIM LINE FROM NJDEP DIVISION OF COASTAL RESOURCES, ATLAS SHEET NO 623-2118

EDGE OF WATER - APPROXIMATE HIGH TIDE FROM MAY 2008 E-005 DRAWING

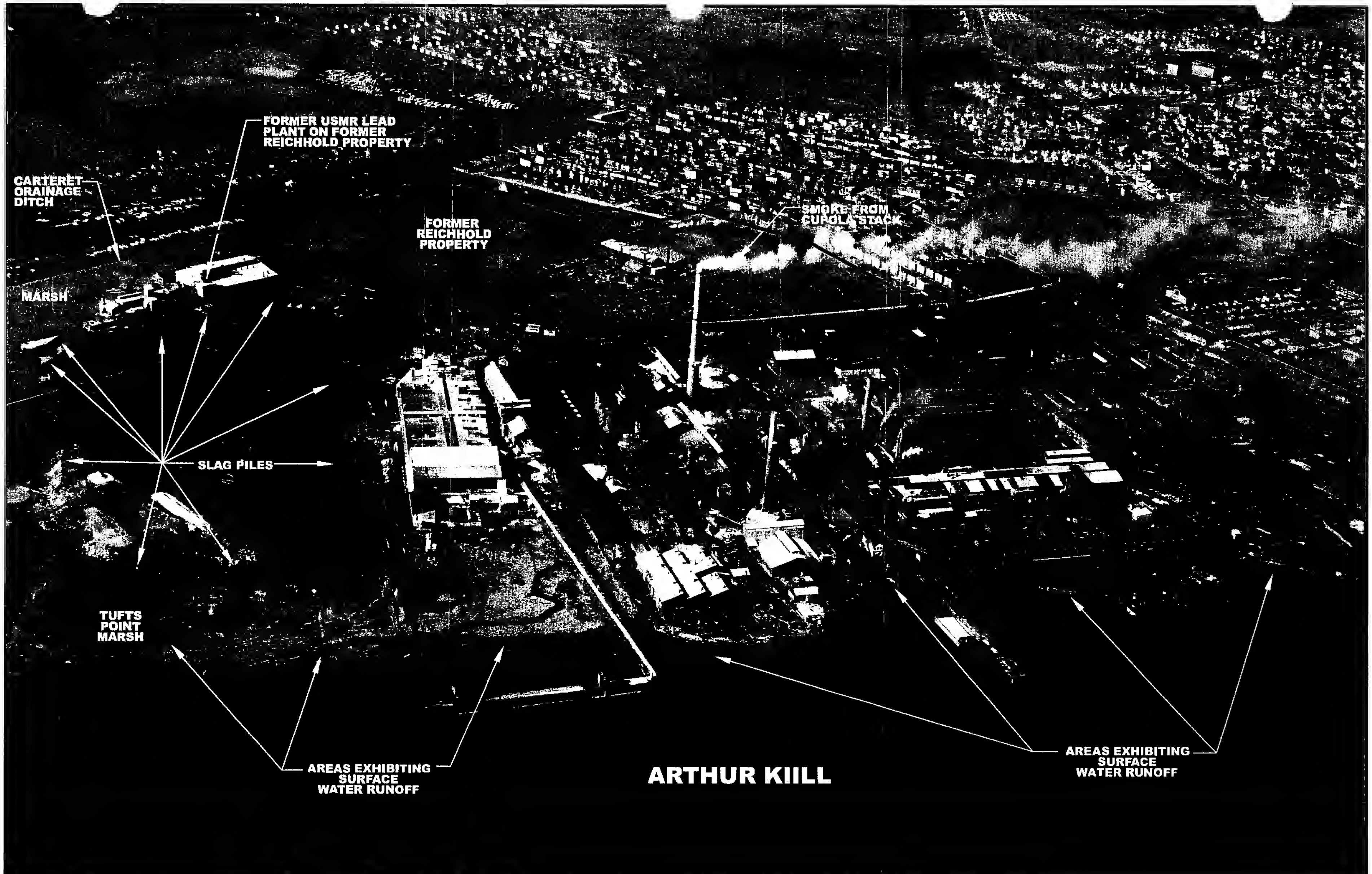
10-FOOT CONTOUR FROM JUNE 2008 SITE SURVEY

0 100 200 300
SCALE IN FEET

Figure 2-4
Former Reichhold Carteret Property
1984 Aerial Photograph

CH2MHILL

f56_33820



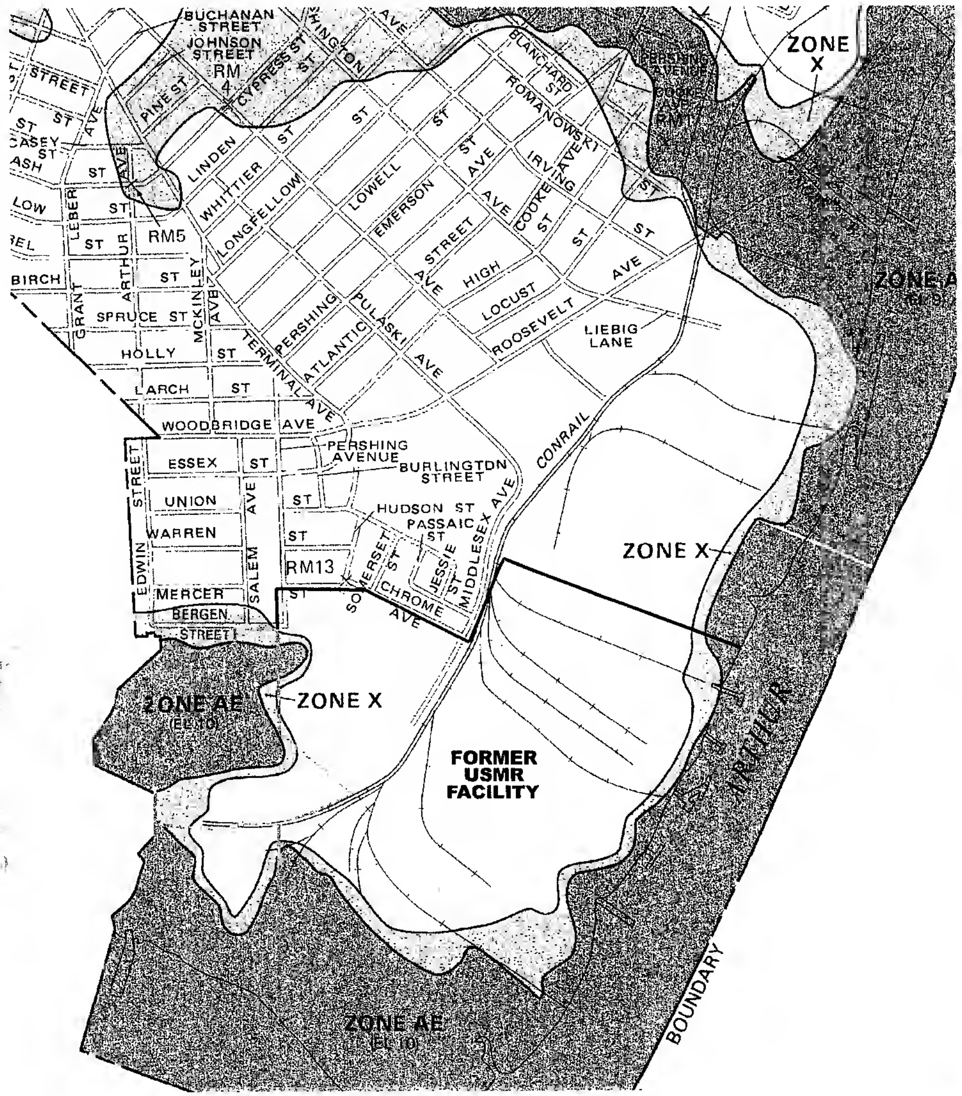
LEGEND

PROPERTY BOUNDARIES ARE APPROXIMATE

Figure 3-1
Former USMR Facility
Uncontrolled Stormwater Runoff
1948 Aerial Photograph

CH2MHILL

f15_338202.dgn



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood

OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

	Floodplain Boundary
	Floodway Boundary
	Zone D Boundary
	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
~~513~~~	Base Flood Elevation Line; Elevation in Feet*
(D)——(D)	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7x	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for possible updated flood hazard information prior to use of this map for property purchase or construction purposes.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Areas of special flood hazard (100-year flood) include Zones A, AE, AH, AO, A99, V, and VE

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations

NOTES:
1. ADAPTED FROM THE FEDERAL EMERGENCY MANAGEMENT AGENCY 'FLOOD INSURANCE RATE MAP AND STREET INDEX,' BOROUGH OF CARTERET, NJ, COMMUNITY-PANEL NUMBER 340257 0005 B, APRIL 15, 1992
2. PROPERTY BOUNDARIES ARE APPROXIMATE

Figure 3-2
Flood Insurance Rate Map and Property Boundaries

CH2MHILL

f08_3382(n

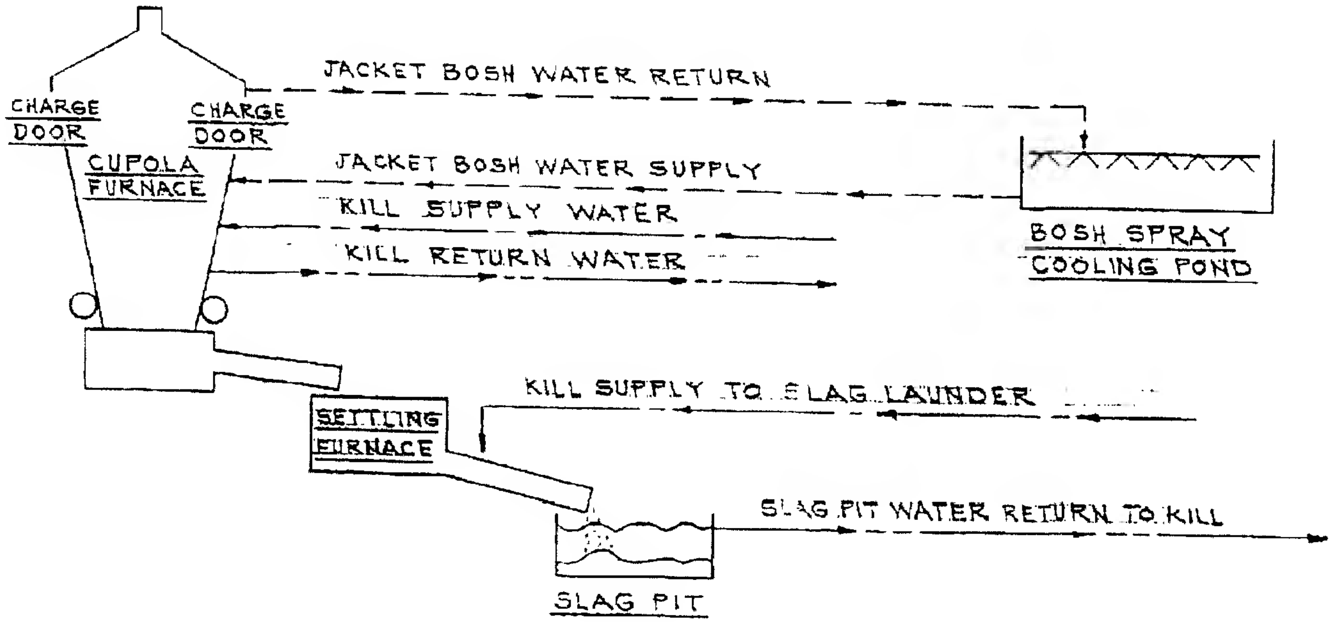


FIGURE 11

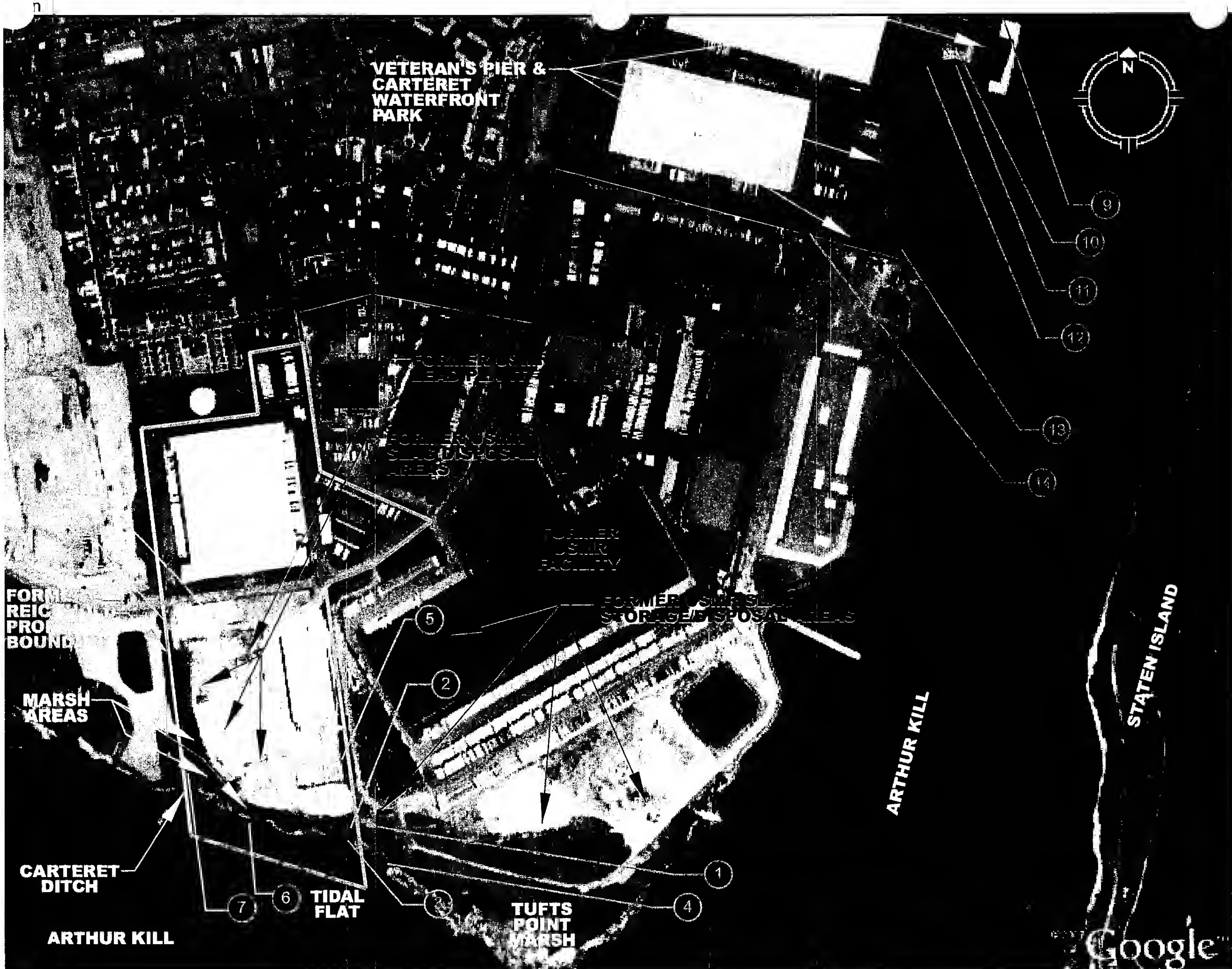
PRESENT CUPOLA WATEF SYSTEM

Source: USMR 007250

Figure 3-3
Schematic Layout for Direct Discharge of Wastewater to Arthur Kill

CH2MHILL

f37_3382C n



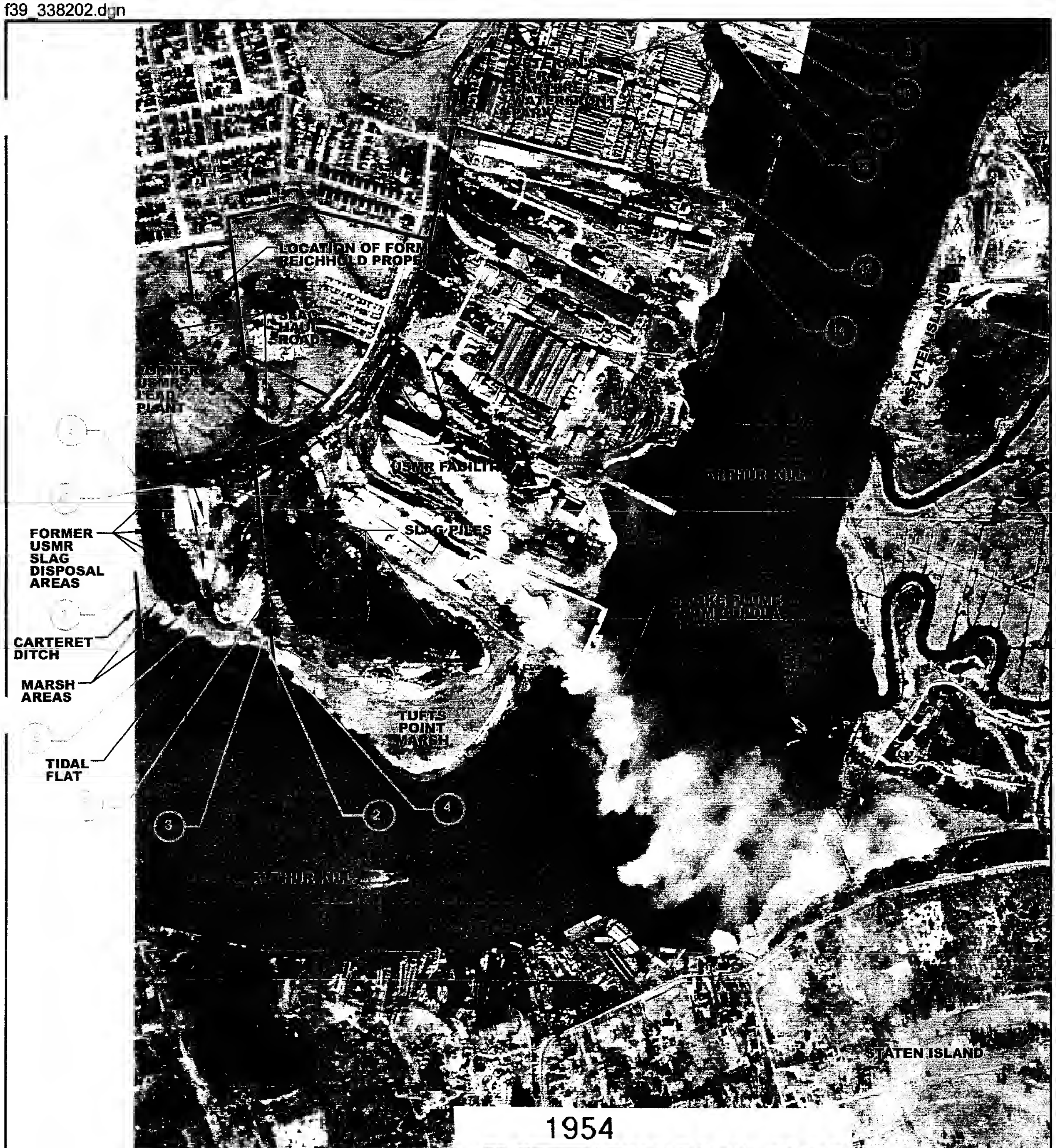
LEGEND

PHOTOGRAPH LOCATION

Figure 3-4
Locations of April 2008 to June 2008 Photographs on 2008 Aerial Photograph of Former USMR Facility

CH2MHILL

f39_338202.dgn



LEGEND:

PROPERTY BOUNDARIES

PHOTOGRAPH LOCATION

NOTES:
VERTICAL DATUM = N.G.V.D. 1929
FORMER REICHHOLD SITE PROPERTY BOUNDARIES ARE BASED ON TOPOGRAPHIC SURVEY DATA FROM MAY 2008; THE SOUTHERN PROPERTY BOUNDARY OF THE FORMER REICHHOLD SITE REPRESENTS THE US GOVERNMENT BULKHEAD LINE ADOPTED BY THE RIPARIAN COMMISSION ON JANUARY 9, 1912.
USMR PROPERTY BOUNDARIES ARE APPROXIMATE.

N

0 375 750
GRAPHIC SCALE (FT)

Figure 3-5
Locations of April 2008 to June 2008 Photographs Shown on 1954 Aerial Photograph of Former USMR Facility

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Appendix A

Expansion of USMR Facility

Attachment A

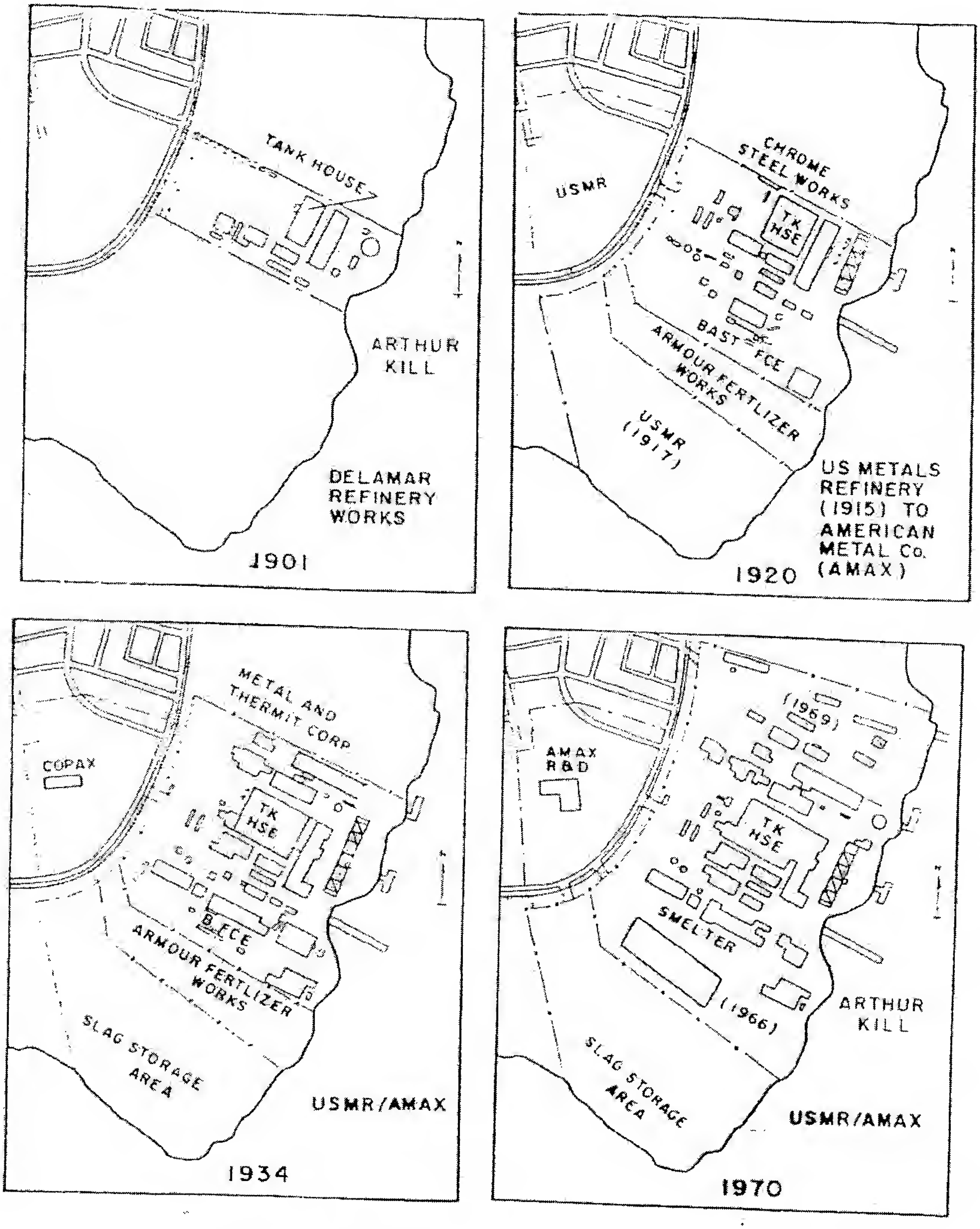
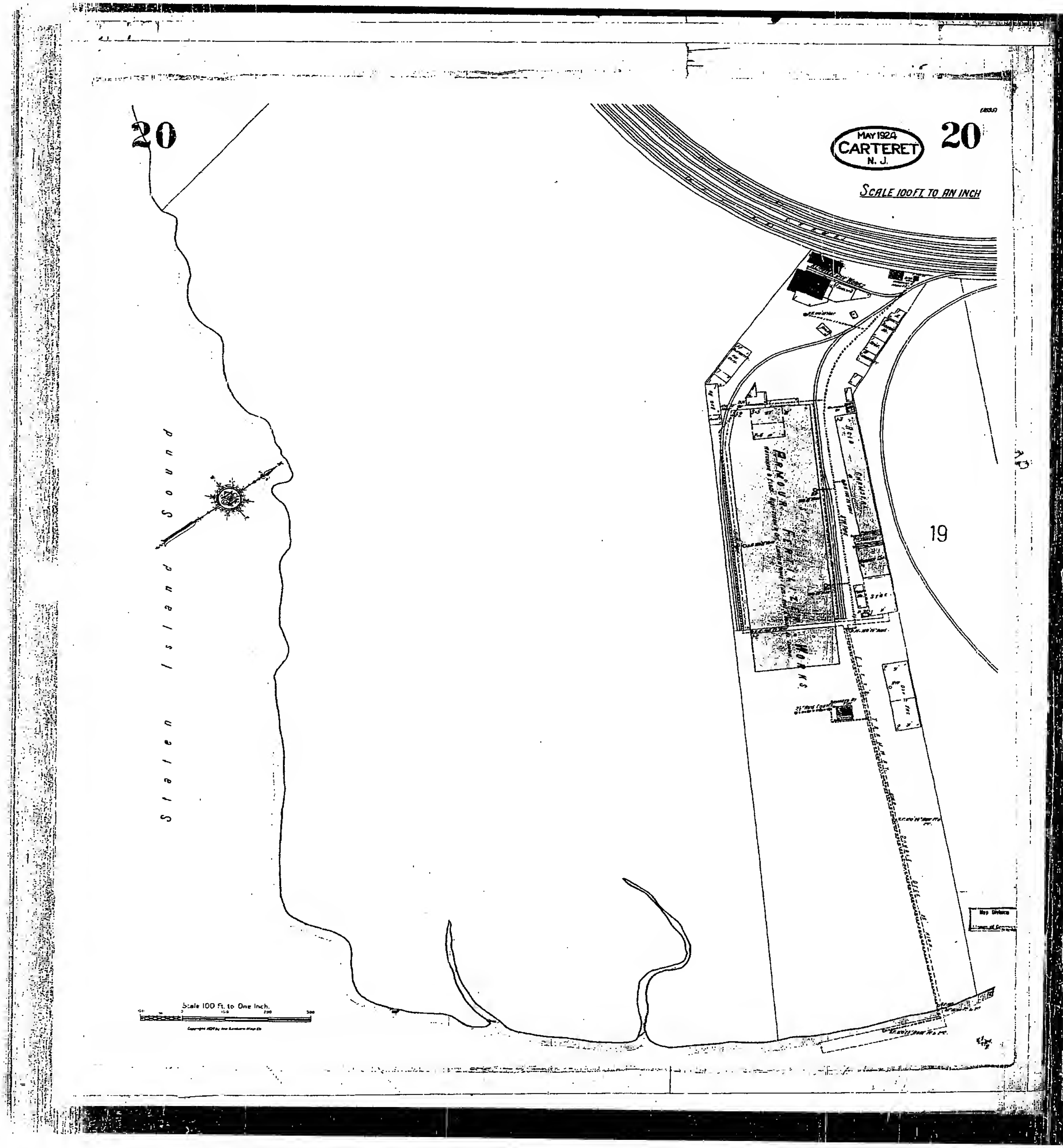


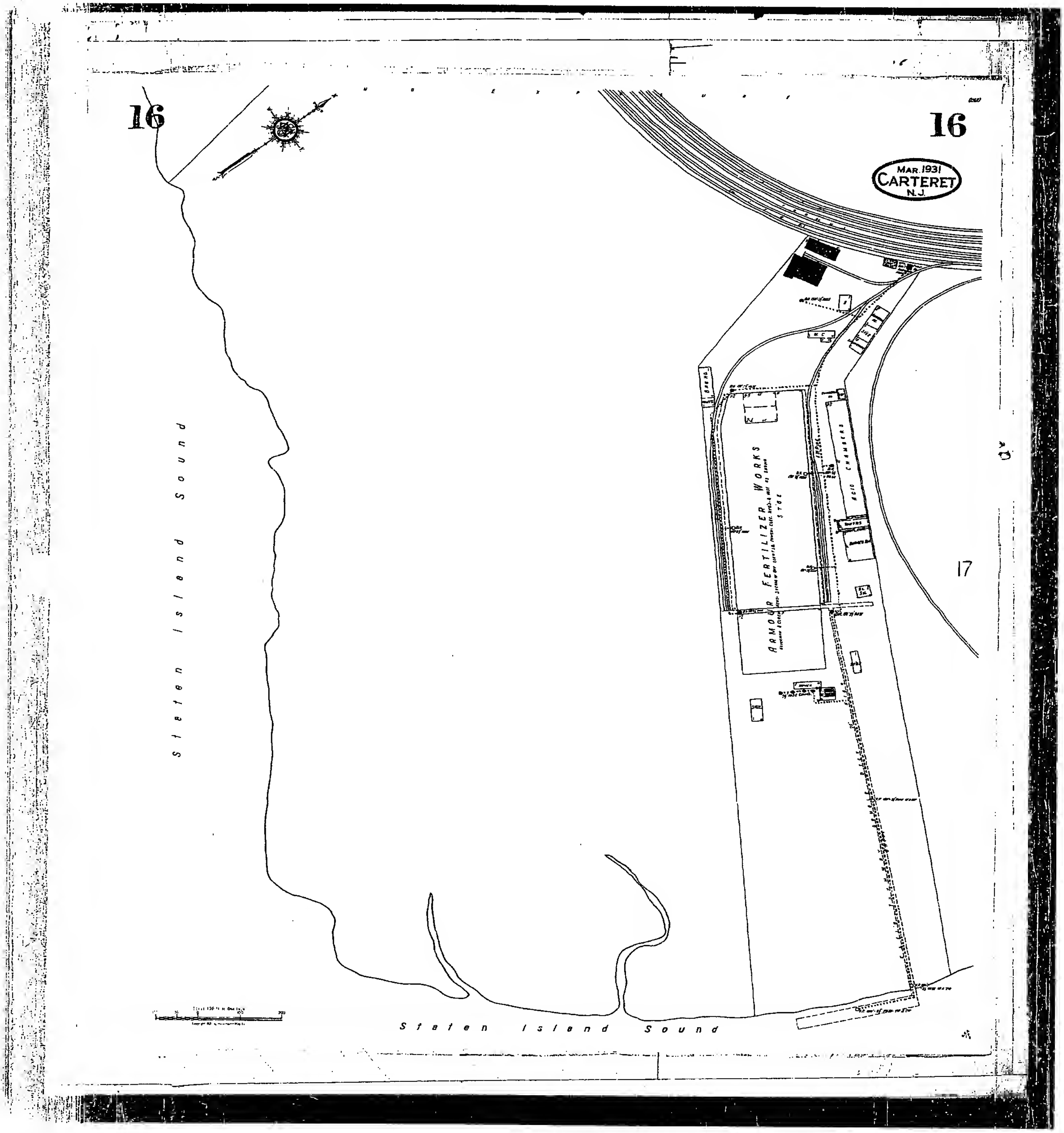
FIGURE 1-3. HISTORICAL DEVELOPMENT OF THE AMAX SITE

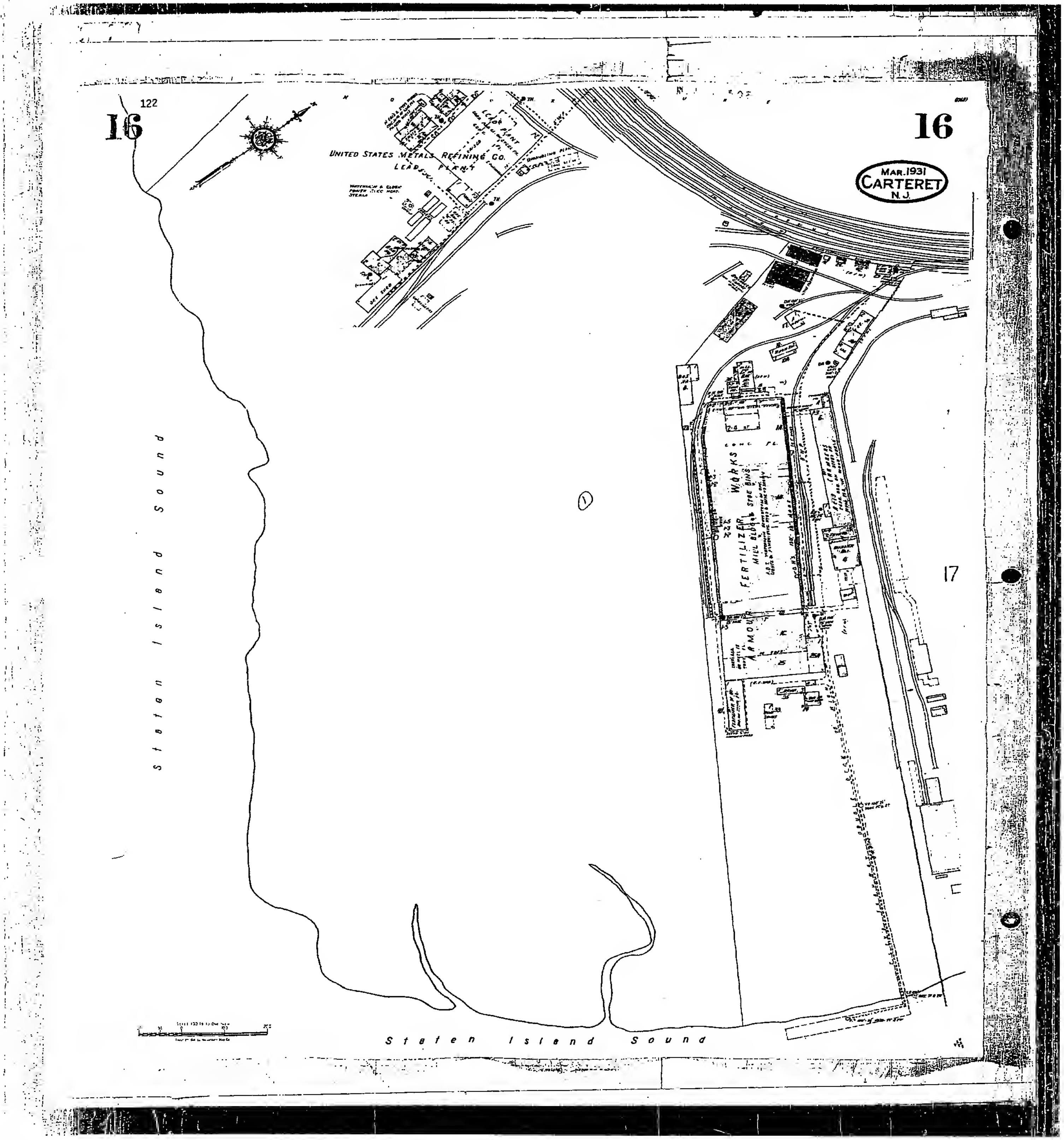
USMR 004141

Appendix B

Sanborn® Maps


20
MAY 1924
CARTERET
N. J.
20
SCALE 100 FT. TO AN INCH
Staten Island Sound
19
Scale 100 Ft. to One Inch.

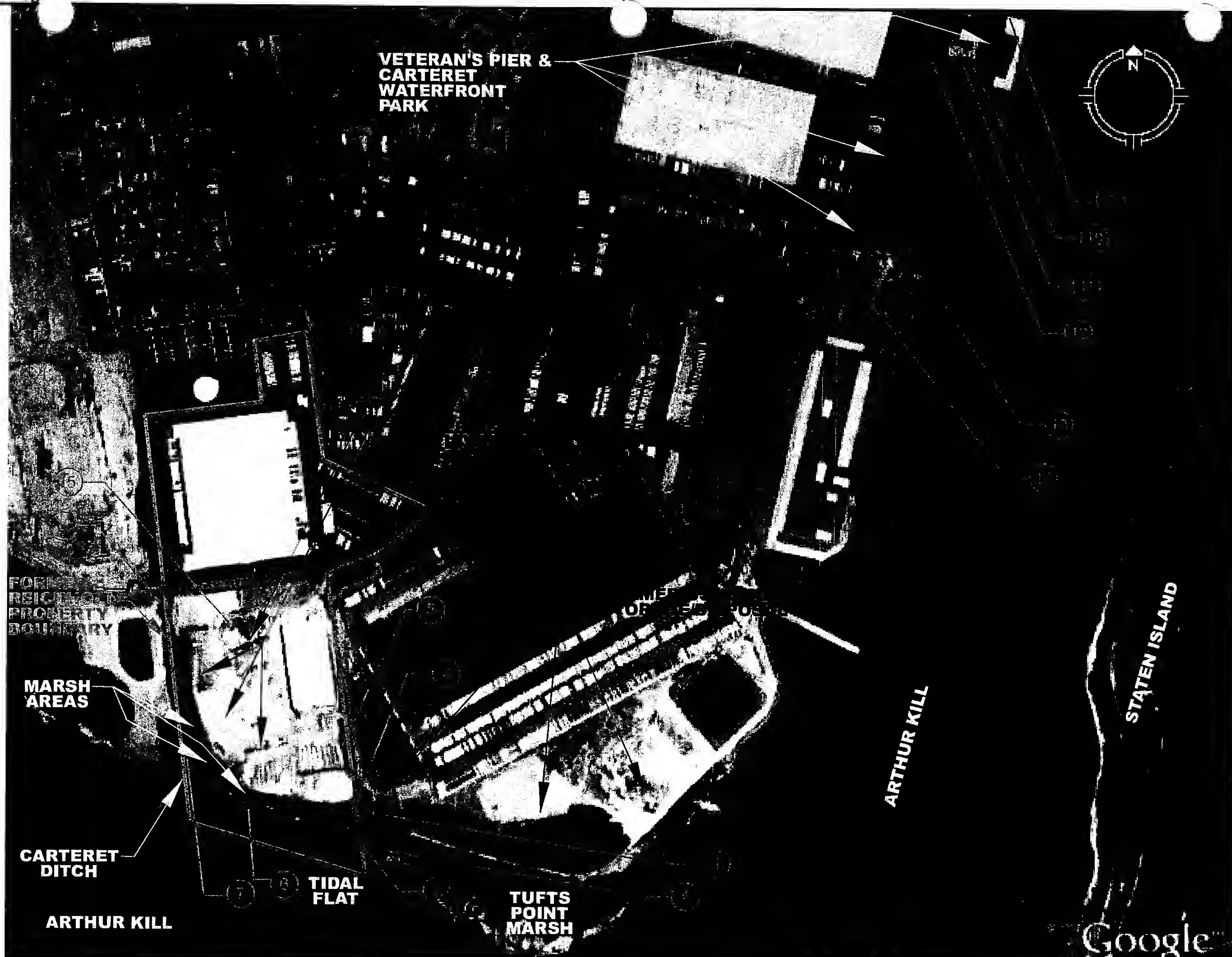

16
16
MAR. 1931
CARTERET
N.J.
Staten Island Sound
Staten Island Sound
ARMOUR FERTILIZER WORKS
ACID CHAMBERS
17


16
122
16
MAR. 1931
CARTERET
N.J.
UNITED STATES METALS REFINING CO.
Staten Island Sound
Staten Island Sound
FERTILIZER WORKS
ARMOUR
17

Appendix C

Photograph Logs Showing Existing Surface Occurrences of Slag in 2007 and 2008

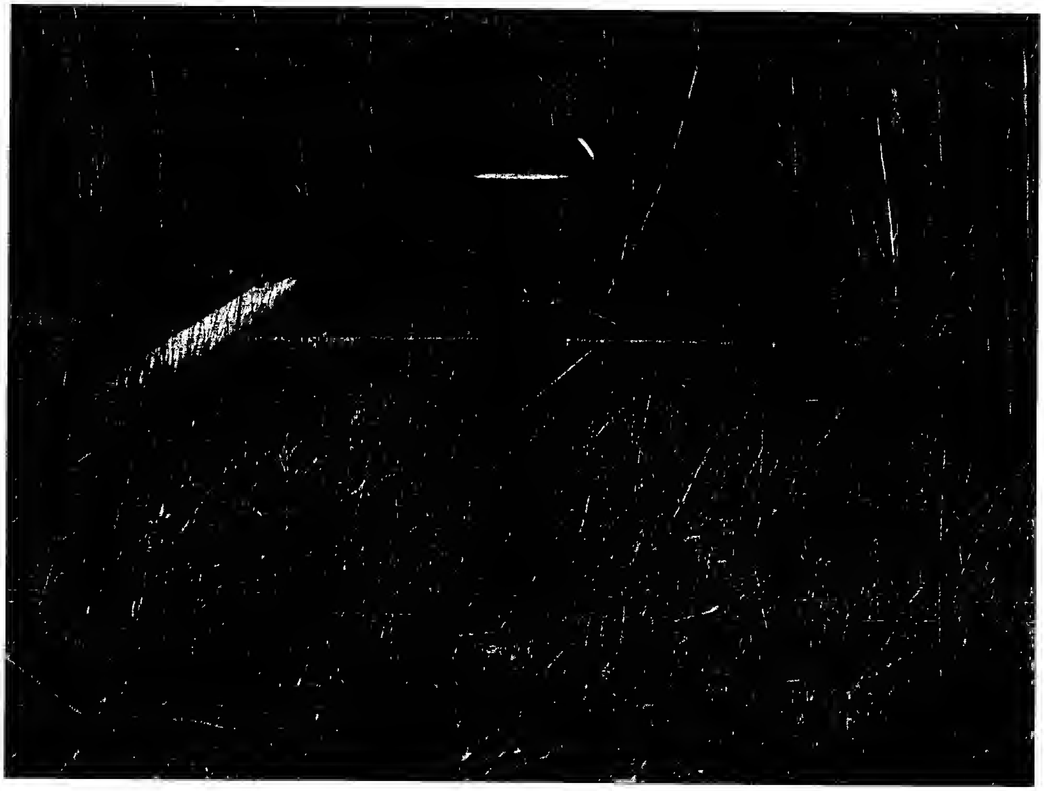
f37_338202.dgn



LEGEND
(1) PHOTOGRAPH LOCATION

Figure 3-4
Locations of April 2008 to June 2008 Photographs on 2008 Aerial Photograph of Former USMR Facility

CH2MHILL



LOCATION 1-PHOTO 1: U.S. METALS REFINING (USMR) COMPANY MONITORING WELL (MW) AT EDGE OF TUFTS POINT MARSH (04/23/2008).

LOCATION 1 PHOTO 2: USMR PROPERTY NEAR MW, TUFTS POINT MARSH, AND ARTHUR KILL WITH SLAG COVERED SOILS IN FOREGROUND (04/23/2008).

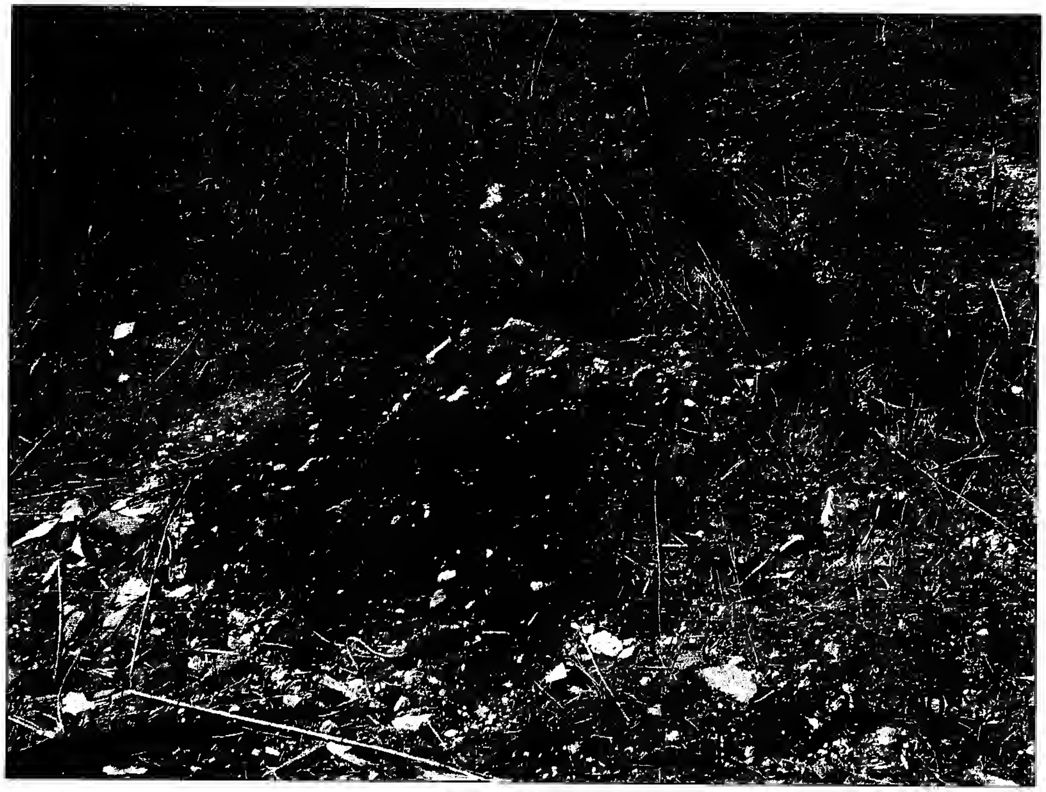
CH2MHILL

fig 1a_loc1_338202.dgn

LOCATION 1-PHOTO 3: USMR PROPERTY SLAG COVERED SOILS NEAR MW, TUFTS POINT MARSH, AND FORMER USMR SLAG STORAGE AREA (04/23/2008).

LOCATION 1-PHOTO 4: CLOSE-UP VIEW OF USMR PROPERTY SLAG COVERED SOILS NEAR MW, TUFTS POINT MARSH, AND FORMER USMR SLAG STORAGE AREA (04/23/2008).

CH2MHILL



LOCATION 2-PHOTO 1: ANIMAL BURROW AT BASE OF FILL COVERED SLOPE NEAR FORMER REICHHOLD/USMR PROPERTY LINE (04/23/2008).

LOCATION 2-PHOTO 2: ANIMAL BURROW AT BASE OF FORMER USMR SLAG STORAGE/DISPOSAL AREA FILL SLOPE WITH EXCAVATED SLAG COVERED SOILS EVIDENT (04/23/2008).

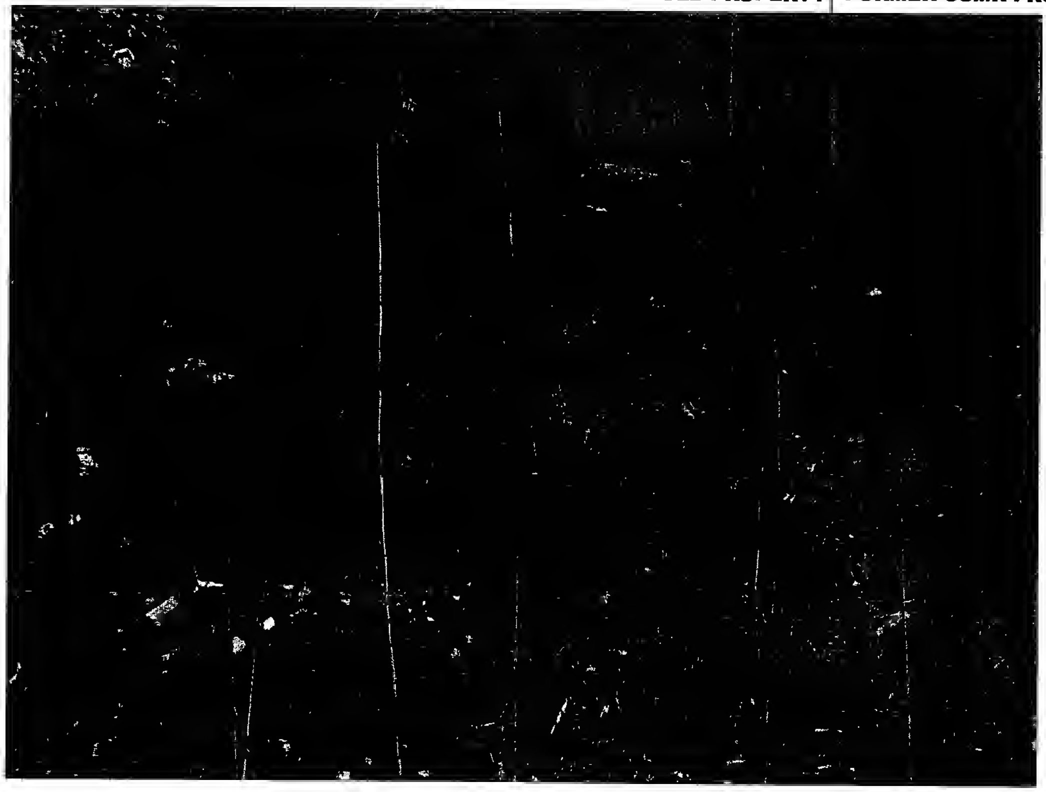
CH2MHILL

LOCATION 2-PHOTO 3: OPENING OF ANIMAL BURROW AT THE BASE OF FORMER USMR SLAG STORAGE AREA FILL SLOPE NEAR FORMER REICHHOLD/ USMR PROPERTY LINE (04/23/2008).

LOCATION 2-PHOTO 4: CLOSE-UP VIEW OF ANIMAL EXCAVATED SLAG COVERED SOILS AT ANIMAL BURROW OPENING NEAR FORMER REICHHOLD/USMR PROPERTY LINE (04/23/2008).

CH2MHILL

fig 2b_loc2_338202.dgn

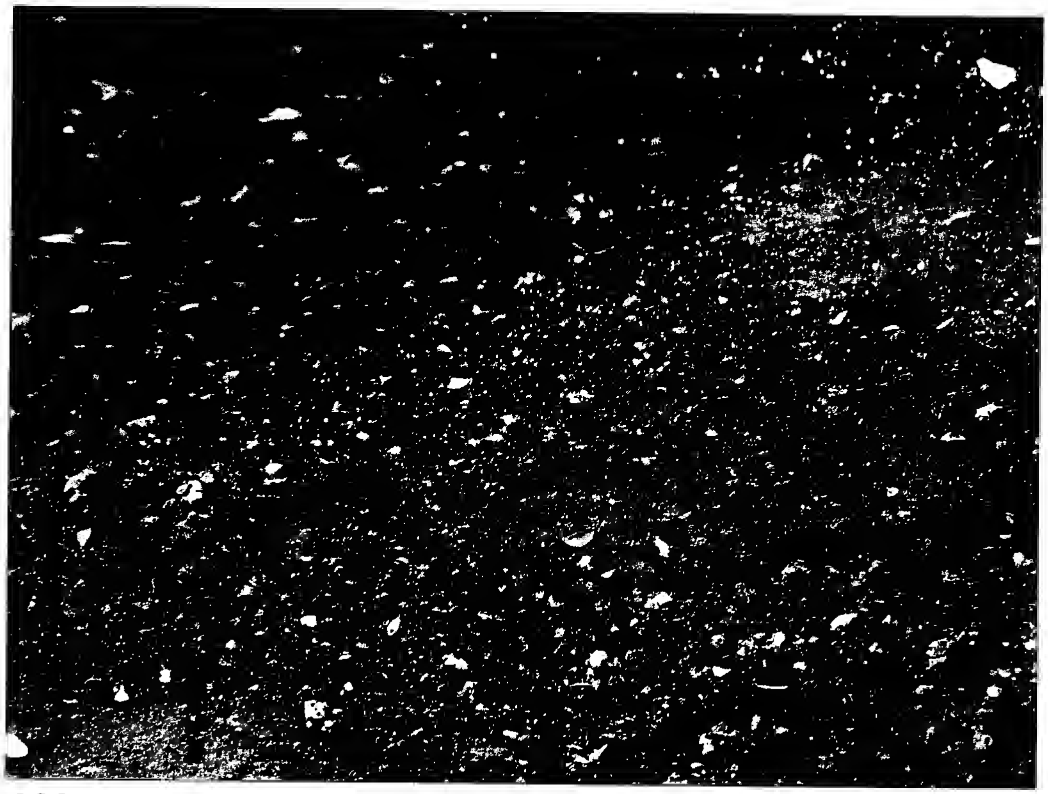


LOCATION 2-PHOTO 5: ANIMAL BURROW WITH SLAG MATERIAL ON SURFACE NEAR PROPERTY LINE AND FENCE LINE OF FORMER REICHHOLD AND FORMER USMR FACILITIES.
(MR. RHODES PHOTOGRAPH, 2008)

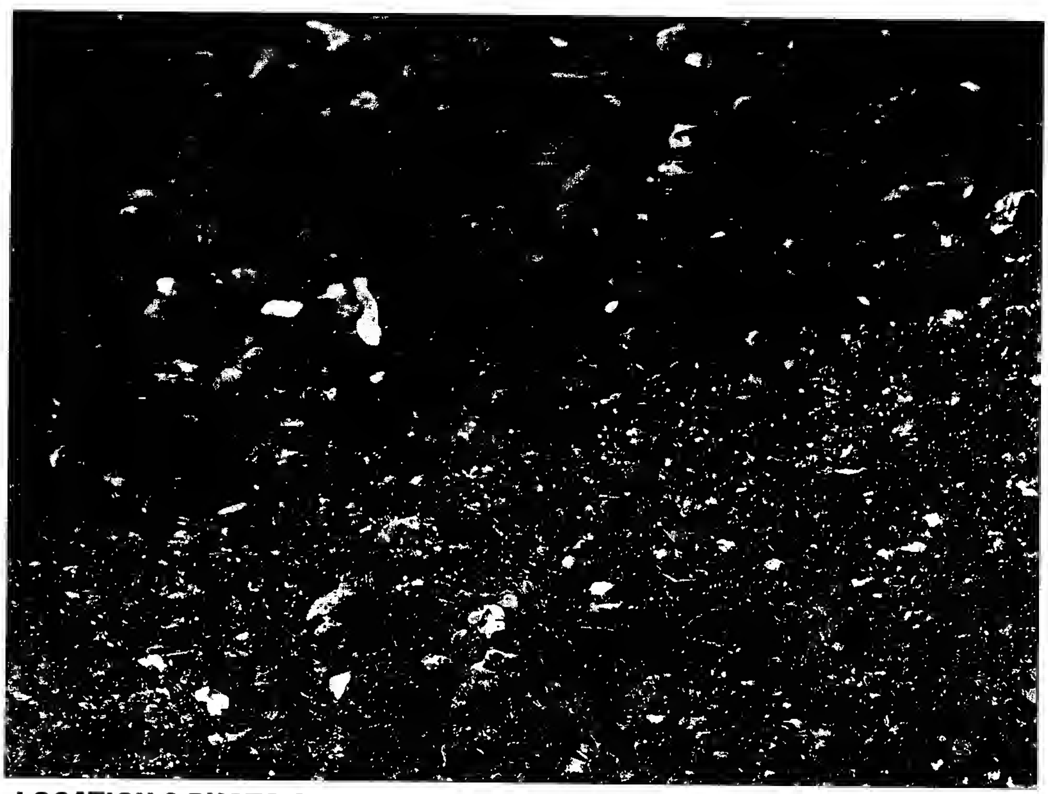
LOCATION 2-PHOTO 6: MIKE BURIANI (NJDEP) AND KEN MCGILL (CH2M HILL) LOOKING AT ANIMAL BURROW WITH SLAG MATERIAL ON SURFACE NEAR PROPERTY LINE (04/17/2008).

LOCATION 4-PHOTO 3: ARTHUR KILL TUFTS POINT MARSH SHORELINE BELOW THE FORMER USMR SLAG STORAGE/ DISPOSAL AREA SHOWING SLAG COVERED SEDIMENTS (04/23/2008).

LOCATION 4-PHOTO 4: CLOSE-UP OF SLAG COVERED SEDIMENTS AT ARTHUR KILL WATER'S EDGE BELOW TUFTS POINT MARSH AND FORMER USMR SLAG STORAGE/DISPOSAL AREA. SAMPLE COLLECTED (04/23/2008).



LOCATION 3-PHOTO 1: SLAG COVERED SEDIMENTS AT ARTHUR KILL SHORELINE NEAR FORMER REICHHOLD/USMR PROPERTY LINE (04/23/2008).



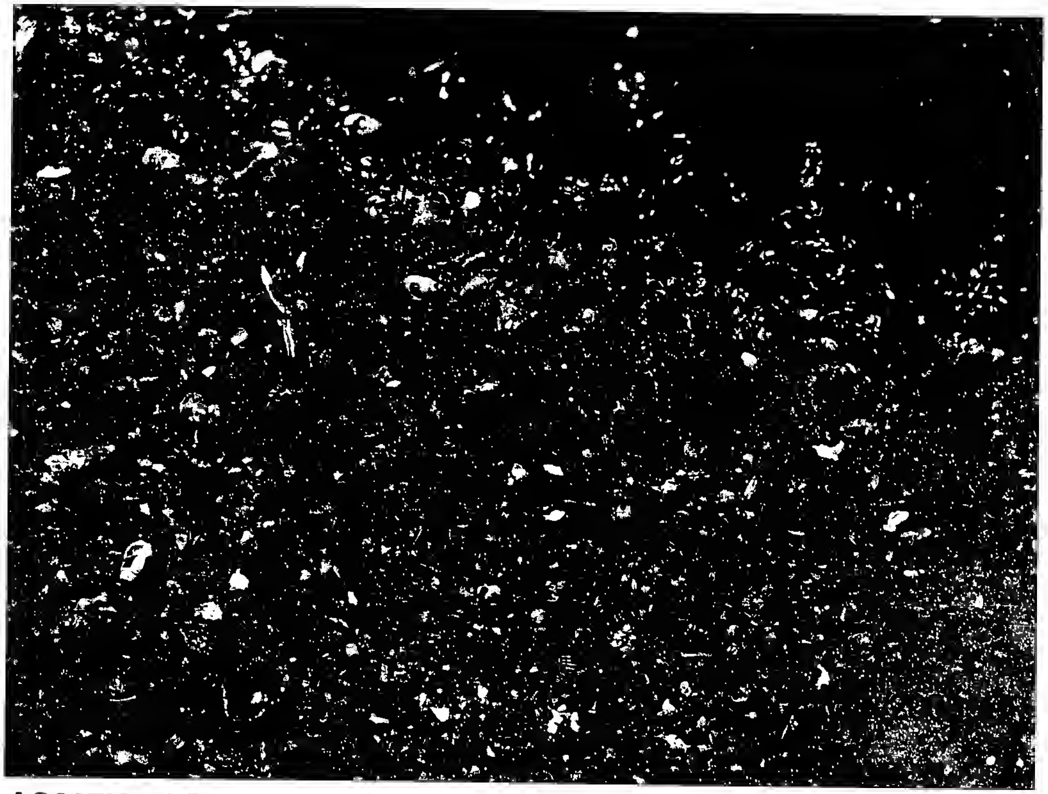
LOCATION 3-PHOTO 2 : SLAG AND SHELL COVERED SEDIMENTS AT SHORELINE OF ARTHUR KILL. SAMPLE COLLECTED (04/23/2008).

CH2MHILL

LOCATION 4-PHOTO 1: ARTHUR KILL SHORELINE BELOW TUFTS POINT MARSH AND THE FORMER USMR SLAG STORAGE/DISPOSAL AREA (04/23/2008).

LOCATION 4-PHOTO 2: ARTHUR KILL TUFTS POINT MARSH SHORELINE BELOW THE FORMER USMR SLAG STORAGE/DISPOSAL AREA (04/23/2008).

CH2MHILL



LOCATION 3-PHOTO 3: SLAG AND SHELL COVERED SEDIMENTS AT ARTHUR KILL SHORELINE NEAR FORMER REICHHOLD/USMR PROPERTY LINE (04/23/2008).

LOCATION 3-PHOTO 4: CLOSE-UP OF SLAG AND SHELL COVERED SEDIMENTS AT ARTHUR KILL SHORELINE NEAR FORMER REICHHOLD/USMR PROPERTY LINE. SAMPLE COLLECTED (04/23/2008).

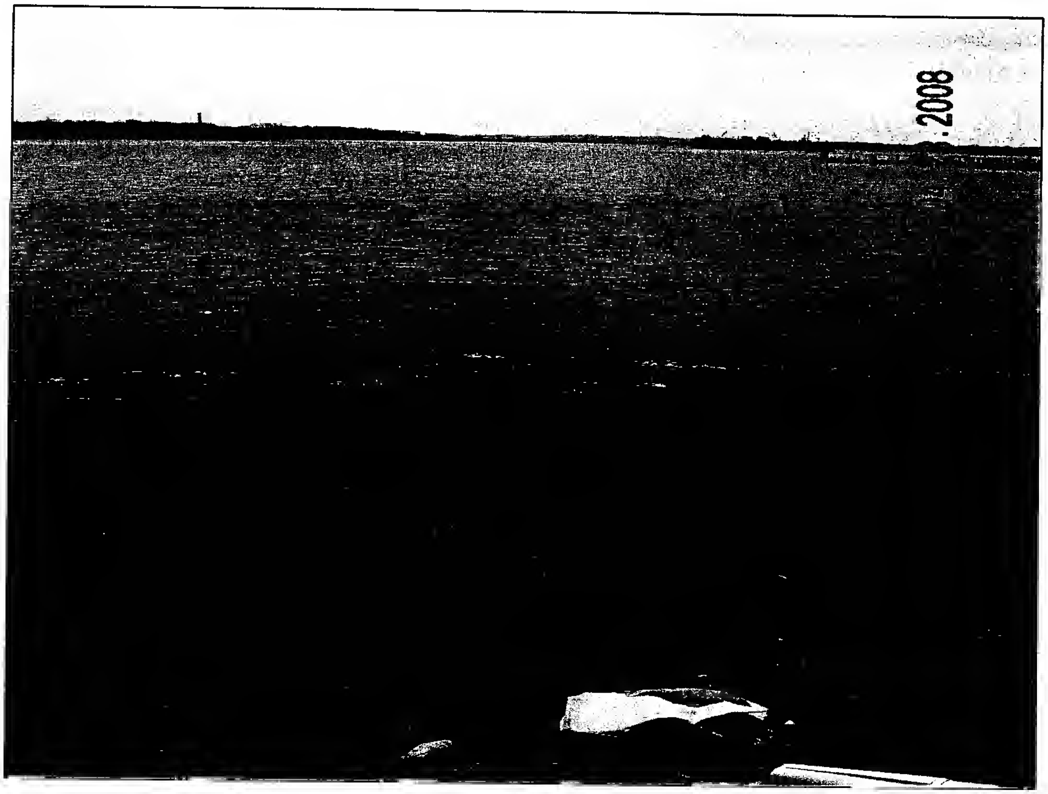
LOCATION 5-PHOTO 1: SLAG MATERIAL ON SURFACE AT EDGE OF FORMER REICHHOLD AND USMR PROPERTY AND FENCE LINE NEAR CONCRETE BLOCKS (WINTER 2008).

LOCATION 5-PHOTO 2: SLAG MATERIAL ON SURFACE AT EDGE OF FORMER REICHHOLD AND USMR PROPERTY AND FENCE LINE NEAR CONCRETE BLOCKS (06/25/2008).

CH2MHILL

fig 5c_loc5_338202.dgn

LOCATION 5-PHOTO 3: SLAG MATERIAL ON SURFACE SOILS AT EDGE OF FORMER REICHHOLD AND USMR PROPERTY AND FENCE LINE NEAR CONCRETE BLOCKS (06/25/2008).

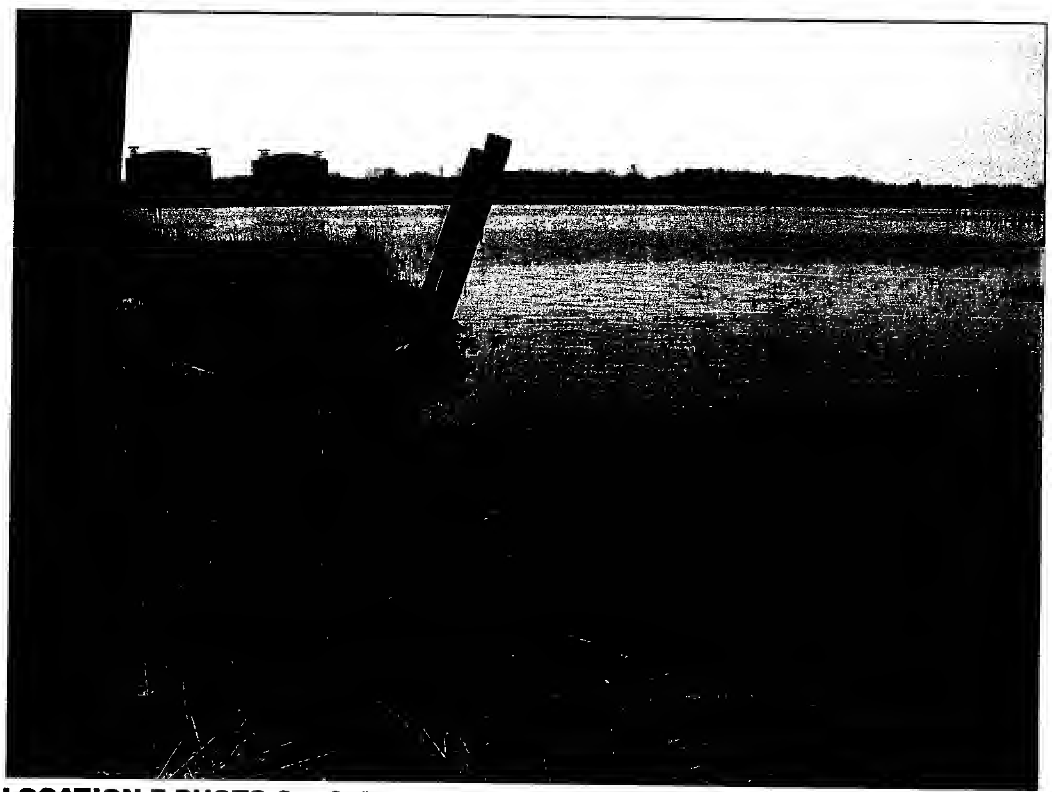


LOCATION 6-PHOTO 1: ARTHUR KILL SHORELINE LOOKING SOUTHWEST DOWN SLOPE OF FORMER USMR SLAG DISPOSAL AREAS ON THE FORMER REICHHOLD PROPERTY. BLACK SLAG COVERED SEDIMENTS EVIDENT UP TO THE WATER'S EDGE (04/23/2008).

LOCATION 6-PHOTO 2: ARTHUR KILL SHORELINE LOOKING SOUTHWEST DOWN SLOPE OF USMR SLAG DISPOSAL AREAS ON THE FORMER REICHHOLD PROPERTY SHOWING BLACK SLAG COVERED BEACH SEDIMENTS UP TO THE WATER'S EDGE (04/23/2008).

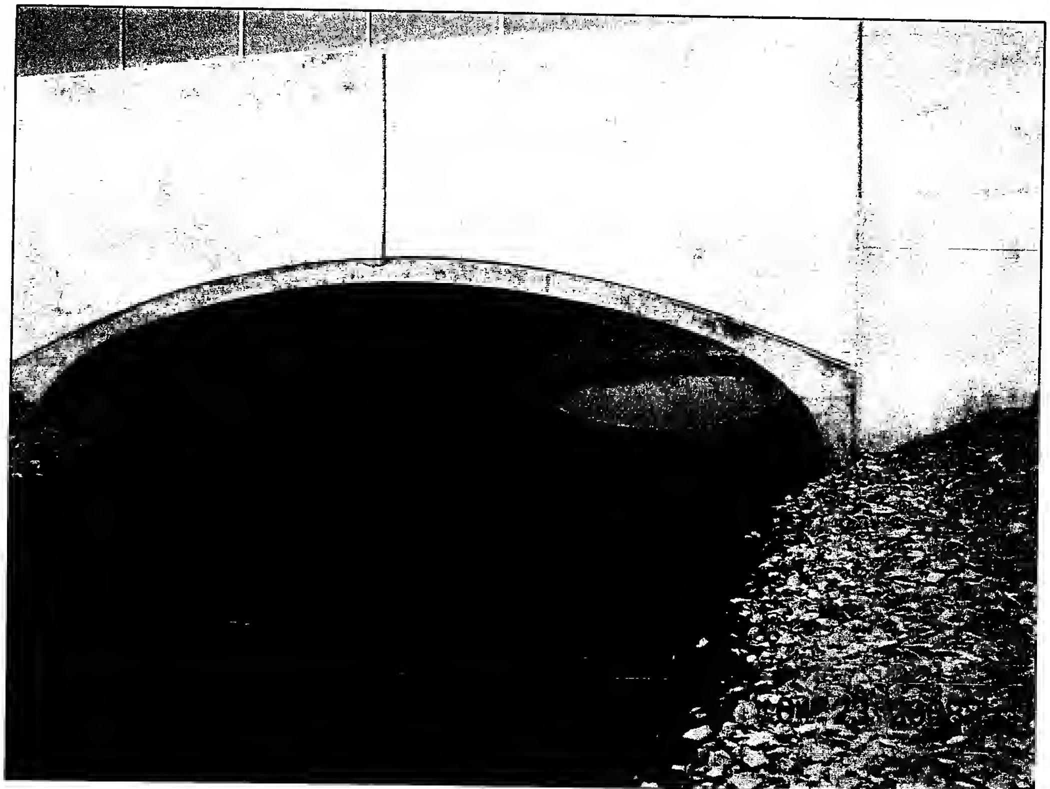
CH2MHILL

LOCATION 7-PHOTO 1: CARTERET DITCH RECENTLY REMEDIATED WITH GEOTEXTILE AND RIPRAP CAP NEAR THE CONFLUENCE WITH THE ARTHUR KILL LOOKING NORTH. LOCATION IS DOWN SLOPE OF USMR SLAG DISPOSAL AREAS ON THE FORMER REICHHOLD PROPERTY (04/23/2008).



LOCATION 7-PHOTO 2: CARTERET DITCH NEAR THE CONFLUENCE WITH THE ARTHUR KILL LOOKING SOUTH . LOCATION IS DOWN SLOPE OF USMR SLAG DISPOSAL AREAS ON FORMER REICHHOLD PROPERTY (04/23/2008).

LOCATION 7-PHOTO 3: SLAG IN SEDIMENTS AT THE EDGE OF CARTERET DITCH NEAR THE CONFLUENCE WITH ARTHUR KILL LOCATED DOWN SLOPE OF USMR SLAG DISPOSAL AREAS ON THE FORMER REICHHOLD PROPERTY (04/23/2008).



LOCATION 8-PHOTO 1: EAST SIDE OF CARTERET DITCH SOUTH OF NEW BRIDGE OVER MIDDLESEX AVENUE LOOKING NORTH. CARTERET DITCH RECENTLY REMEDIATED WITH A GEOTEXTILE AND RIPRAP CAP. LOCATION IS DOWN SLOPE OF THE FORMER USMR LEAD PLANT AND SLAG DISPOSAL AREAS ON FORMER REICHHOLD PROPERTY (04/23/2008).

LOCATION 8-PHOTO 2: EAST SIDE OF CARTERET DITCH SOUTH OF NEW BRIDGE OVER MIDDLESEX AVENUE BRIDGE LOOKING SOUTH. CARTERET DITCH RECENTLY REMEDIATED WITH A GEOTEXTILE AND RIPRAP CAP. NOTE SILT FENCE. LOCATION IS DOWN SLOPE OF THE FORMER USMR LEAD PLANT AND SLAG DISPOSAL AREAS ON FORMER REICHHOLD PROPERTY (04/23/2008).

LOCATION 8-PHOTO 3: EAST SIDE OF CARTERET DITCH SOUTH OF MIDDLESEX AVENUE BRIDGE, EAST OF THE REMEDIATION CAP SILT FENCE. LOCATION IS DOWN SLOPE OF THE FORMER USMR LEAD PLANT AND SLAG DISPOSAL AREAS ON THE FORMER REICHHOLD PROPERTY. SOILS COVERED WITH SLAG. SAMPLE COLLECTED (04/23/2008).

LOCATION 8-PHOTO 4: EAST SIDE OF CARTERET DITCH SOUTH OF MIDDLESEX AVENUE BRIDGE, EAST OF THE REMEDIATION CAP SILT FENCE. CLOSE-UP OF SLAG COVERED SOILS AT LOCATION DOWN SLOPE OF THE FORMER USMR LEAD PLANT AND SLAG DISPOSAL AREAS OF FORMER REICHHOLD PROPERTY (04/23/2008).

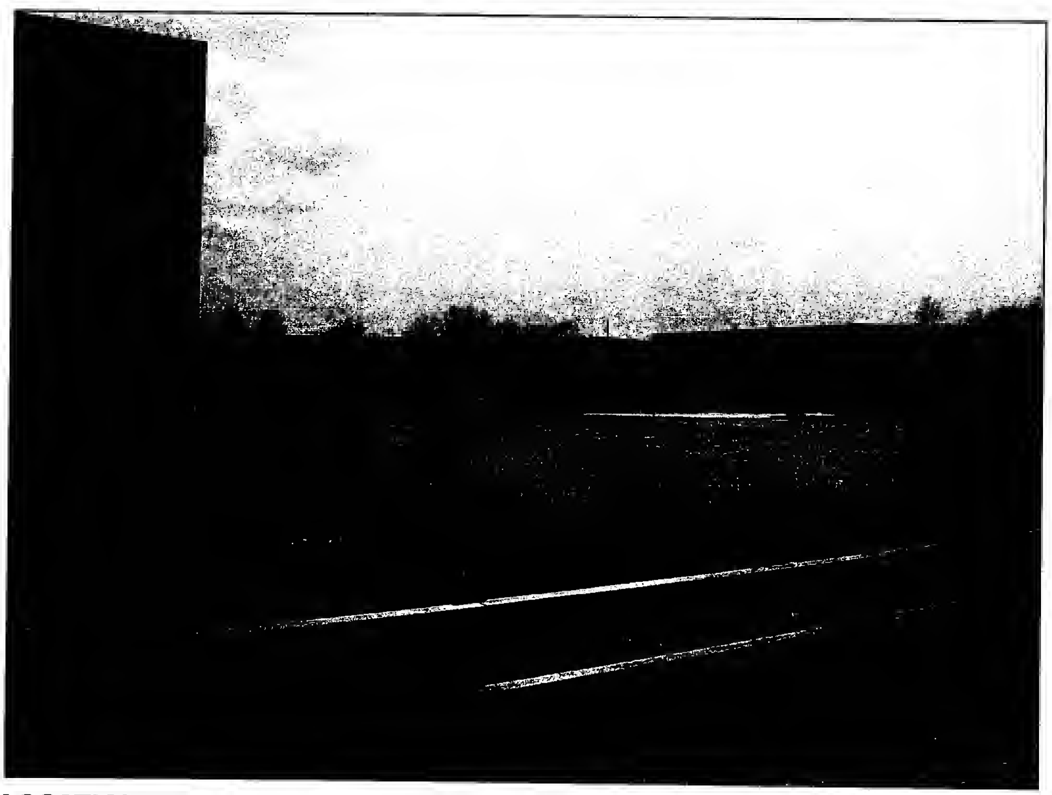
LOCATION 9-PHOTO 1: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK BOAT LAUNCH ON ARTHUR KILL LOCATED APPROXIMATELY 1,000 FEET NORTHEAST OF THE FORMER USMR FACILITY (04/23/2008).

LOCATION 9-PHOTO 2: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOCATED APPROXIMATELY 1,000 FEET NORTHEAST OF THE FORMER USMR FACILITY. NOTE DANGER SIGN ON PIER ENTRANCE (04/23/2008).

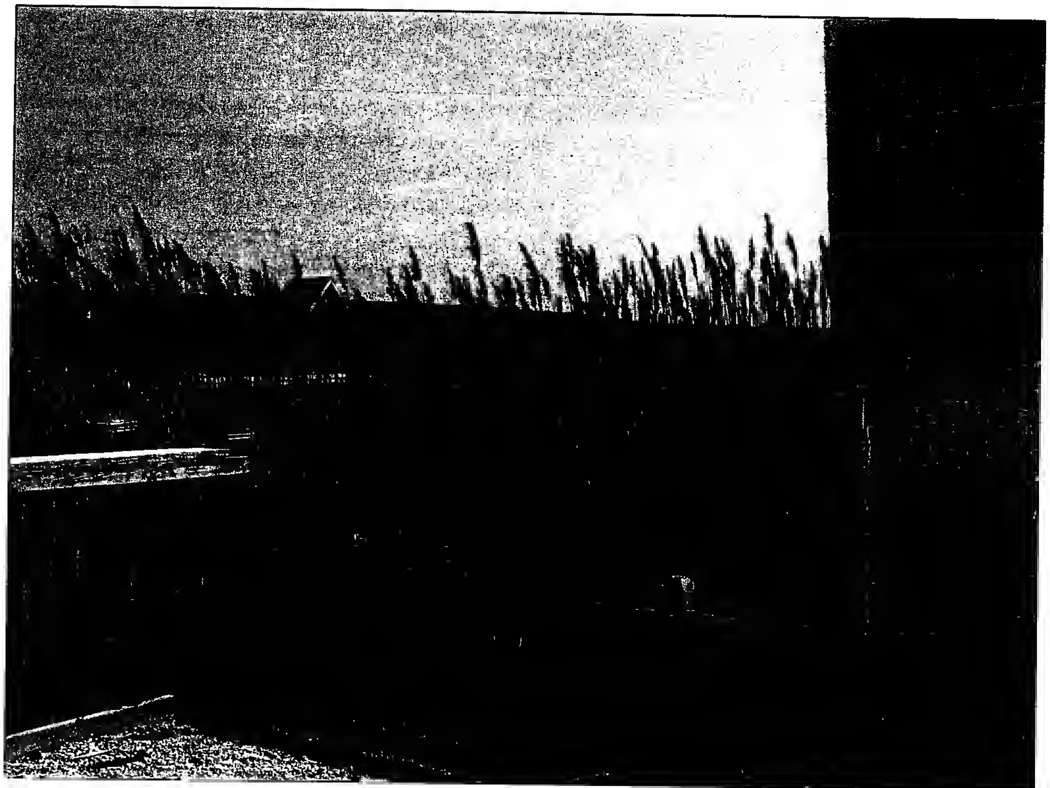
LOCATION 9-PHOTO 3: DANGER WARNING SIGN ON VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON THE ARTHUR KILL LOCATED ABOUT 1,000 FEET NORTHEAST OF FORMER USMR FACILITY (04/23/2008).

LOCATION 9-PHOTO 4: PARKING LOT AT VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOCATED ABOUT 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. LOOKING SOUTHEAST, NOTE GAZEBO, MINIATURE GOLF COURSE AND PLAYGROUND AT PARK (04/23/2008).

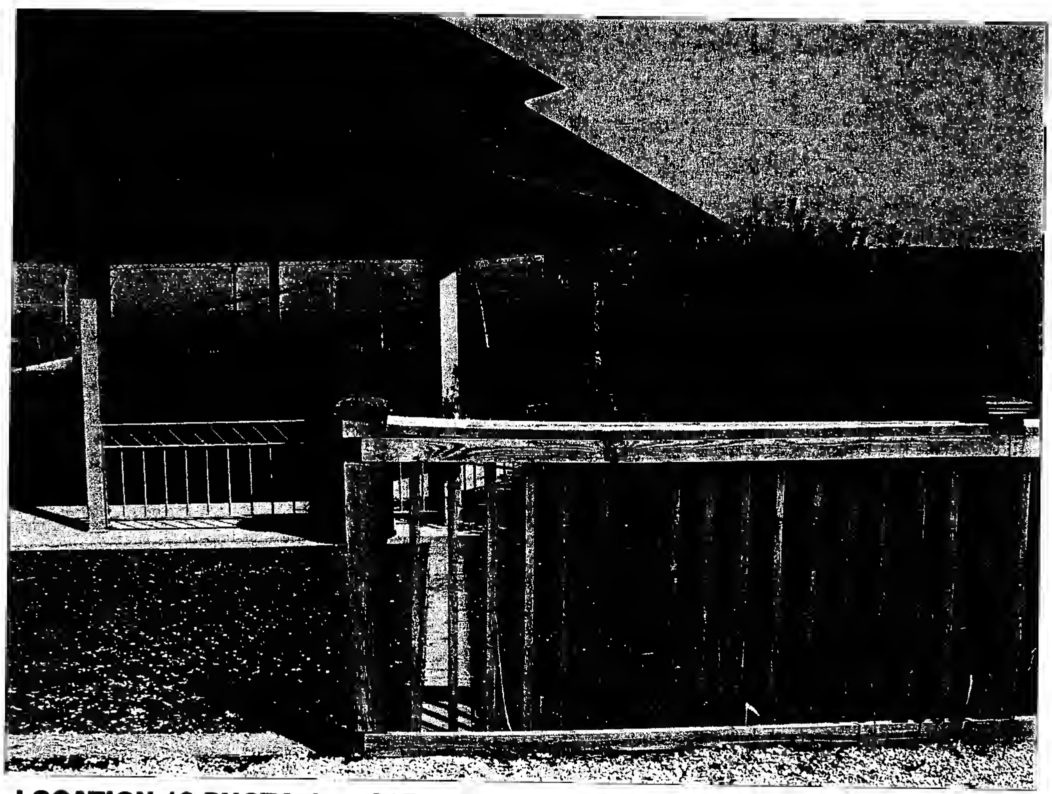
LOCATION 10-PHOTO 1: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOOKING SOUTHWEST ACROSS TIDAL FLAT TOWARD FORMER USMR FACILITY LOCATED ABOUT 1,000 FEET AWAY. NOTE SIGN "FUTURE HOME OF THE CARTERET MUNICIPAL MARINA" (04/23/2008).



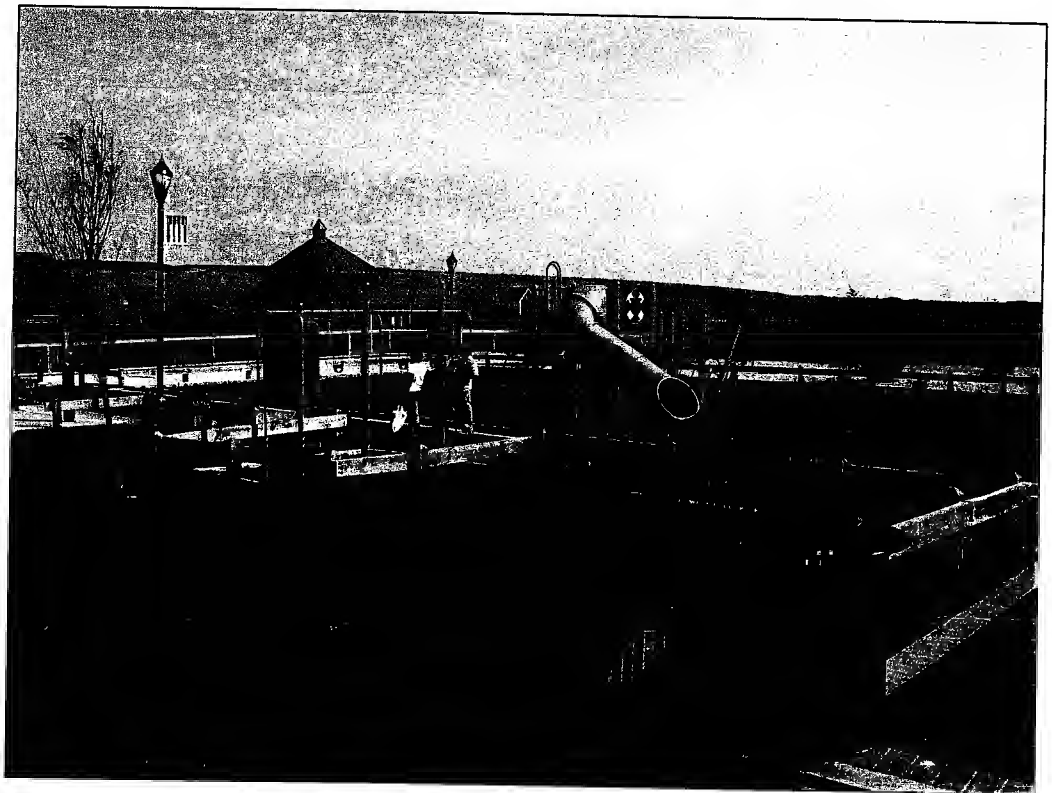
LOCATION 10-PHOTO 2: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOOKING SOUTHWEST ACROSS TIDAL FLAT TOWARD FORMER USMR FACILITY (04/23/2008).



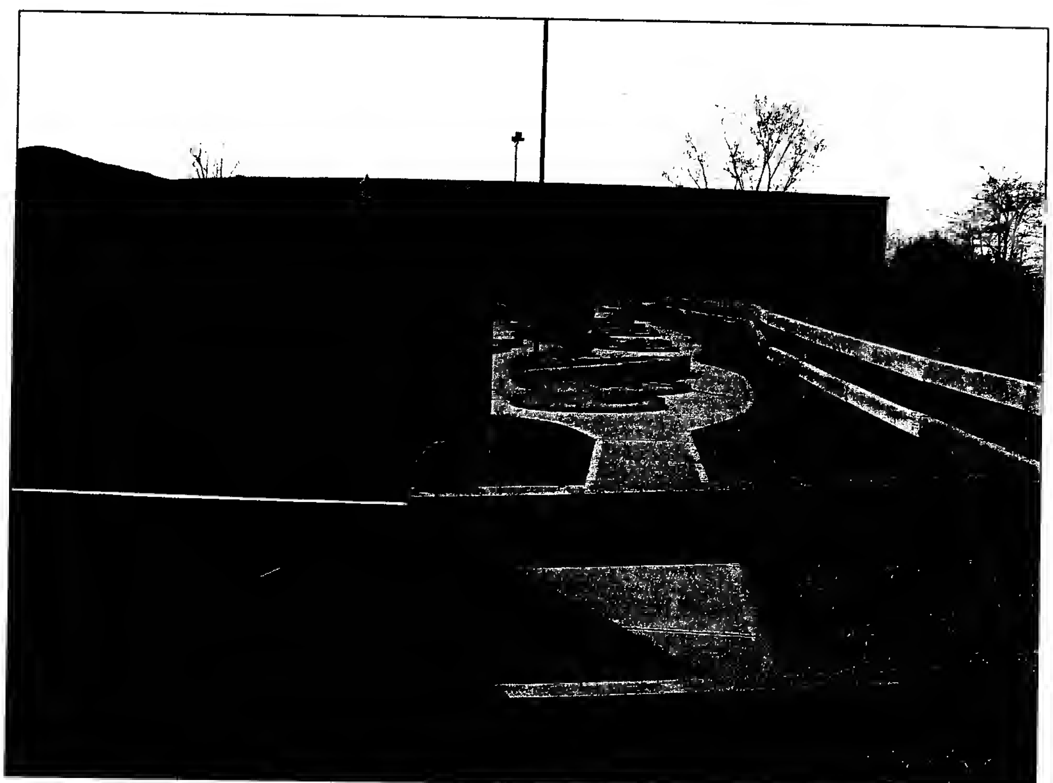
LOCATION 10-PHOTO 3: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOOKING SOUTHEAST ACROSS MARSH AREA TOWARD VETERANS MEMORIAL PIER AND ARTHUR KILL (04/23/2006).



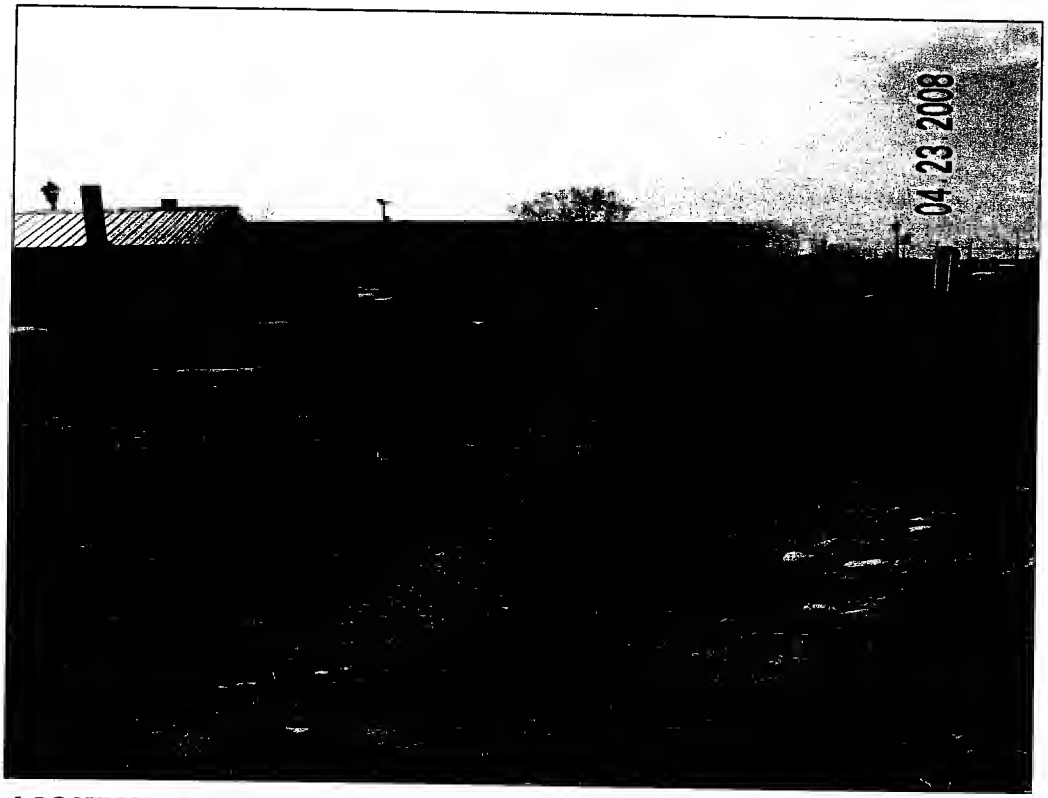
LOCATION 10-PHOTO 4: GAZEBO AT THE VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOCATED APPROXIMATELY 1,000 FEET NORTHEAST OF FORMER USMR FACILITY (04/23/2008).



LOCATION 10-PHOTO 5: PLAYGROUND AT VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK ON ARTHUR KILL LOCATED ABOUT 1,000 FEET NORTHEAST OF FORMER USMR FACILITY (04/23/2008).



LOCATION 10-PHOTO 6: CARTERET WATERFRONT PARK MINIATURE GOLF COURSE NEAR ARTHUR KILL LOCATED ABOUT 1,000 FEET NORTHEAST OF THE FORMER USMR FACILITY (04/23/2008).



LOCATION 10-PHOTO 7: DRAINAGE SWALE THROUGH CARTERET WATERFRONT PARK WHICH DISCHARGES TO THE ARTHUR KILL LOCATED ABOUT 1,000 FEET NORTHEAST OF THE FORMER USMR FACILITY (04/23/2008).

LOCATION 10-PHOTO 8: DRAINAGE SWALE THROUGH CARTERET WATERFRONT PARK LOCATED BETWEEN PARKING LOT AND PLAYGROUND FLOWING TO THE ARTHUR KILL. NOTE RED METALS STAINING OF WATER AND SWALE (04/23/2008).

LOCATION 11-PHOTO 1: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK SHORELINE LOCATED LESS THAN 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. SHORELINE OF ARTHUR KILL TIDAL FLAT NEAR GAZEBO (04/23/2008).

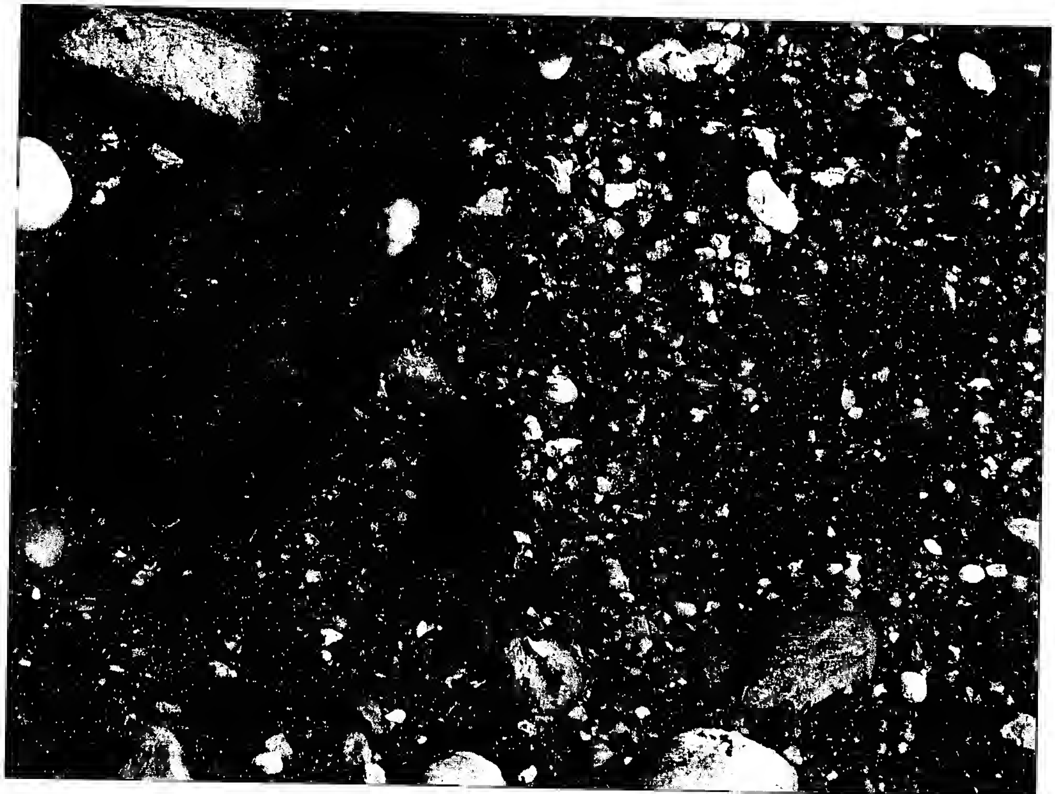
LOCATION 11-PHOTO 2: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK LOCATED LESS THAN 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. NOTE LARGE PIECE OF SLAG ON SHORELINE OF ARTHUR KILL TIDAL FLAT (04/23/2008).

CH2MHILL

LOCATION 11-PHOTO 3: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK SHORELINE OF ARTHUR KILL TIDAL FLAT BELOW GAZEBO (04/23/2008).

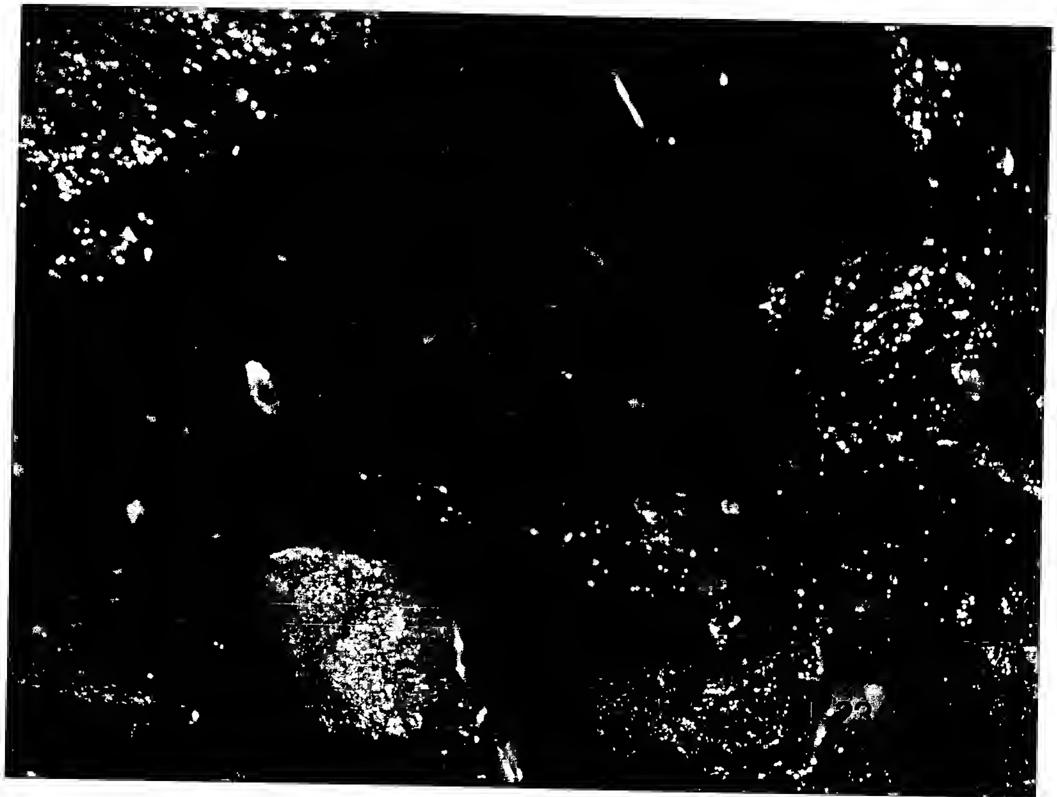
LOCATION 11-PHOTO 4: VETERANS MEMORIAL PIER & CARTERET WATERFRONT PARK SHORELINE OF ARTHUR KILL TIDAL FLAT LOCATED LESS THAN 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. NOTE PIECES OF SLAG ON SHORELINE BEACH SAND AND SEDIMENTS (04/23/2008).

CH2MHILL



LOCATION 11-PHOTO 5: CLOSE-UP OF SLAG MATERIALS ON BEACH SAND AND SEDIMENTS OF VETERANS MEMORIAL PIER AND CARTERET WATERFRONT PARK SHORELINE ALONG ARTHUR KILL TIDAL FLAT, LOCATED LESS THAN 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. NOTE SAMPLES COLLECTED (04/23/2008.)

LOCATION 11-PHOTO 6: VETERANS MEMORIAL PIER AND CARTERET WATERFRONT PARK ON SHORELINE OF ARTHUR KILL TIDAL FLAT LOOKING LESS THAN 1,000 FEET SOUTHWEST TO FORMER USMR FACILITY. NOTE THAT THIS IS THE "FUTURE HOME OF THE CARTERET MUNICIPAL MARINA" LOCATION 10-PHOTO 1 (04/23/2008).



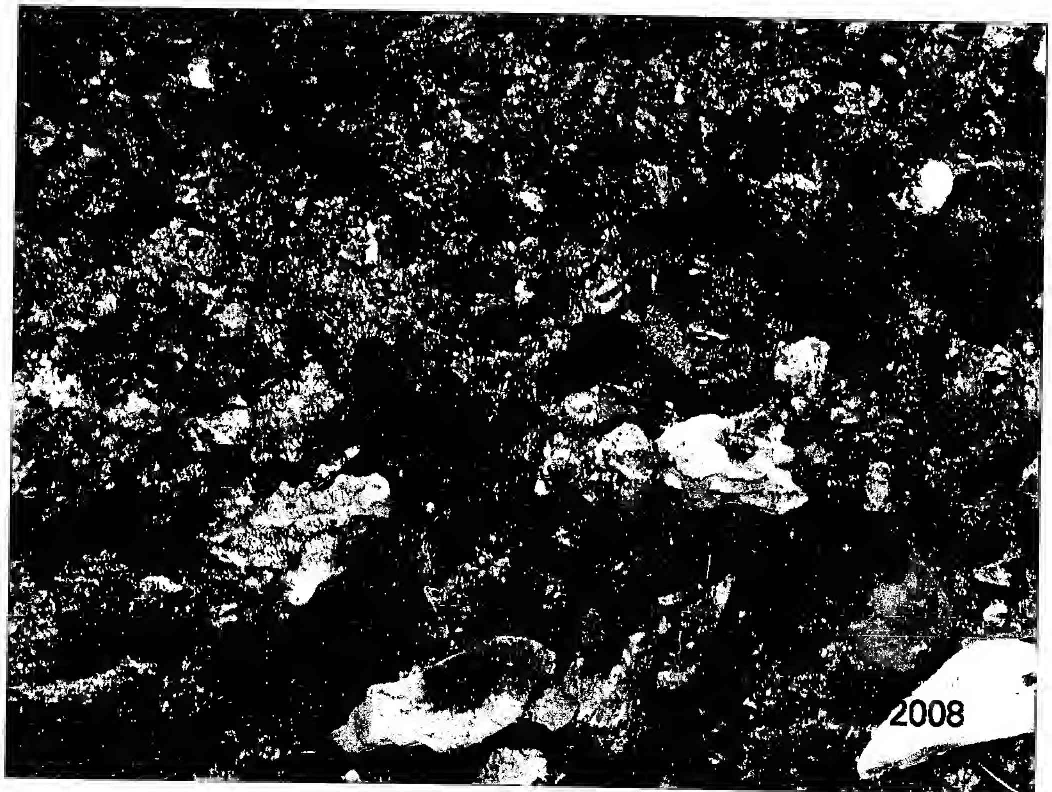
LOCATION 11-PHOTO 7: VETERANS MEMORIAL PIER AND CARTERET WATERFRONT PARK ON SHORELINE OF ARTHUR KILL TIDAL FLAT LOCATED LESS THAN 1,000 FEET NORTHEAST OF FORMER USMR FACILITY. NOTE AQUATIC WORM AND SLAG IN SEDIMENTS (04/23/2008).

LOCATION 12-PHOTO 1: MARSH AREA AT VETERANS MEMORIAL PIER AND CARTERET WATERFRONT PARK ACROSS TIDAL FLAT FROM FORMER USMR FACILITY PROPERTY LOOKING SOUTH (04/23/2008).

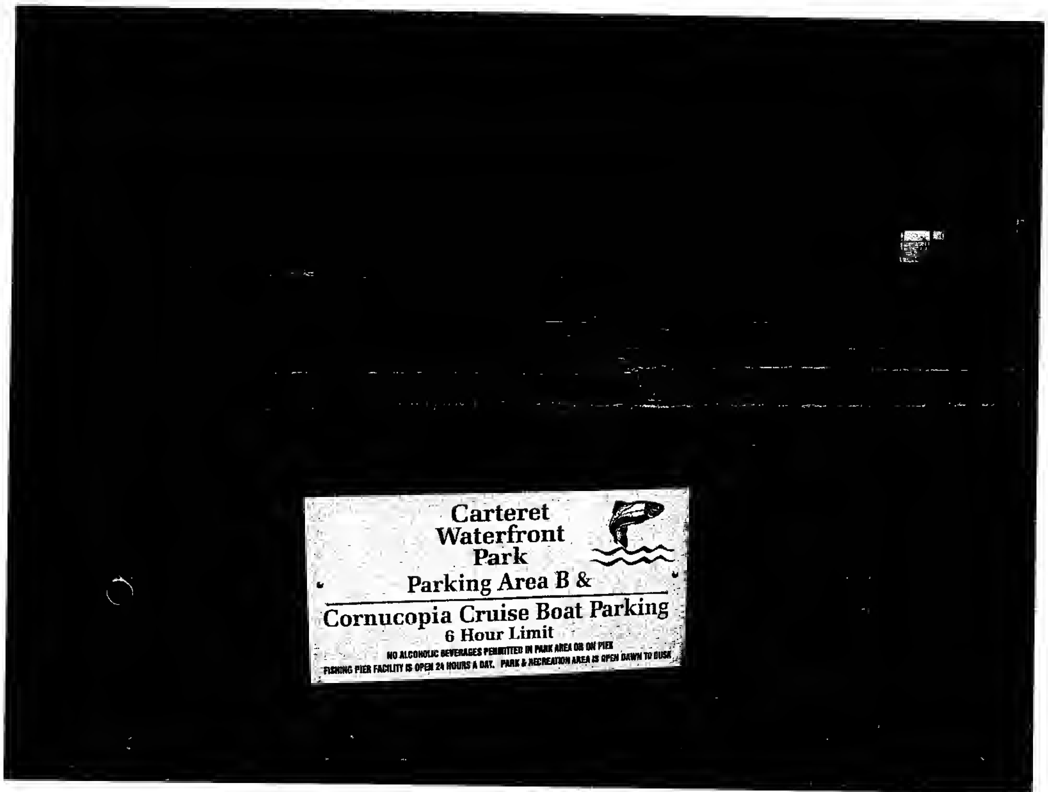
LOCATION 12-PHOTO 2: MUSSELS AND SLAG COVERED SEDIMENTS AT CARTERET WATERFRONT PARK MARSH AREA ACROSS TIDAL FLAT FROM FORMER USMR FACILITY PROPERTY LESS THAN 1,000 FEET TO SOUTH (04/23/2008).

CH2MHILL

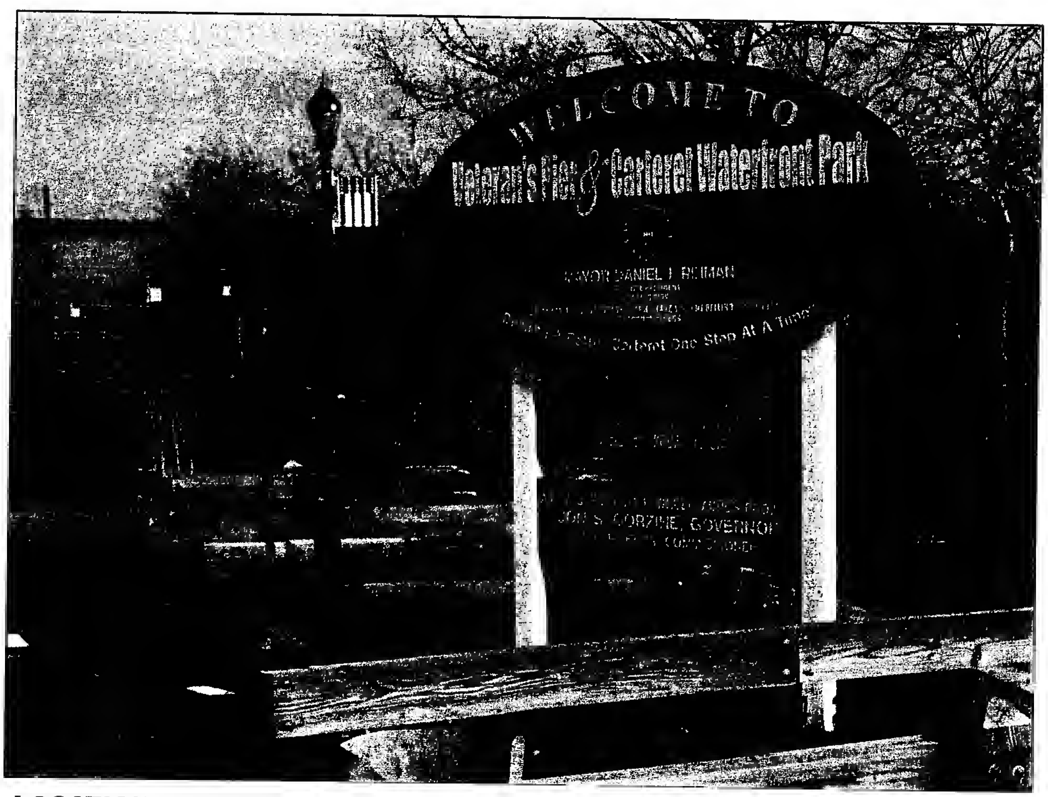
fig 12b_loc12_338202.dgn



LOCATION 13-PHOTO 5: ARTHUR KILL SHORELINE BEACH SEDIMENTS IMMEDIATELY ADJACENT TO FORMER USMR FACILITY PROPERTY. NOTE SLAG MATERIALS COVERING SHORELINE SEDIMENTS; SAMPLE COLLECTED 04/23/2008.

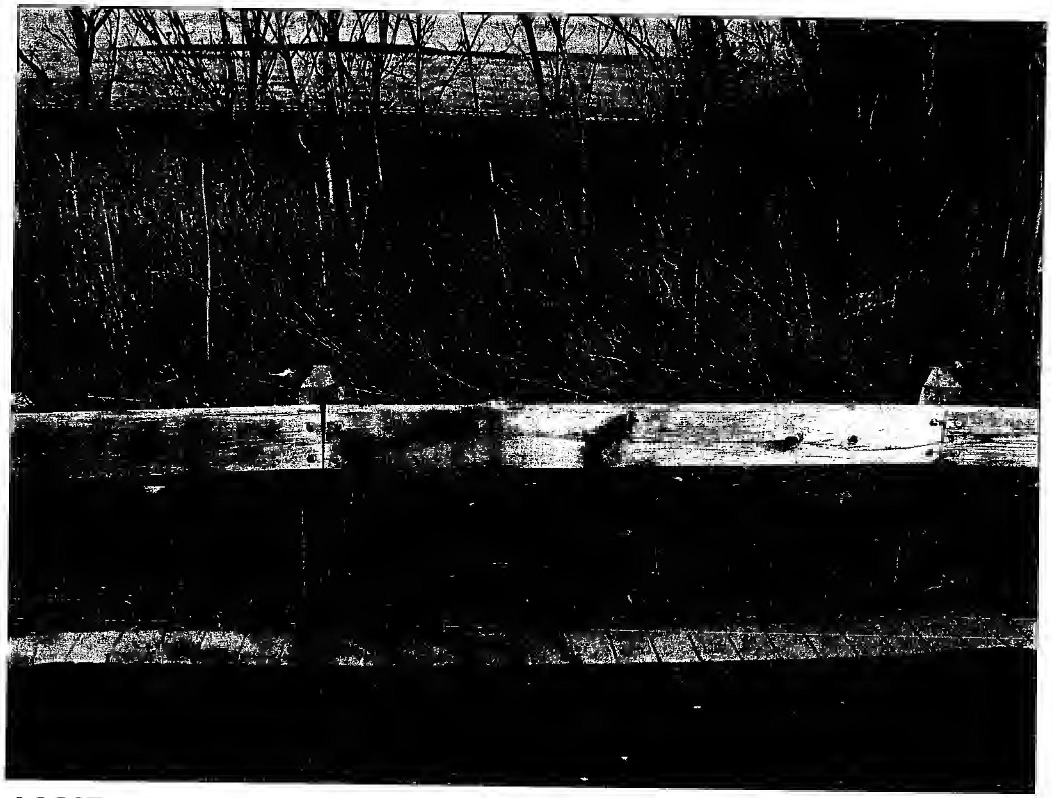


LOCATION 13-PHOTO 1: CARTERET WATERFRONT PARK CORNUCOPIA CRUISE BOAT PARKING LOT COVERED WITH SLAG MATERIAL, LOOKING EAST. LOCATED ABOUT 500 FEET NORTH OF FORMER USMR FACILITY PROPERTY (04/23/2008).



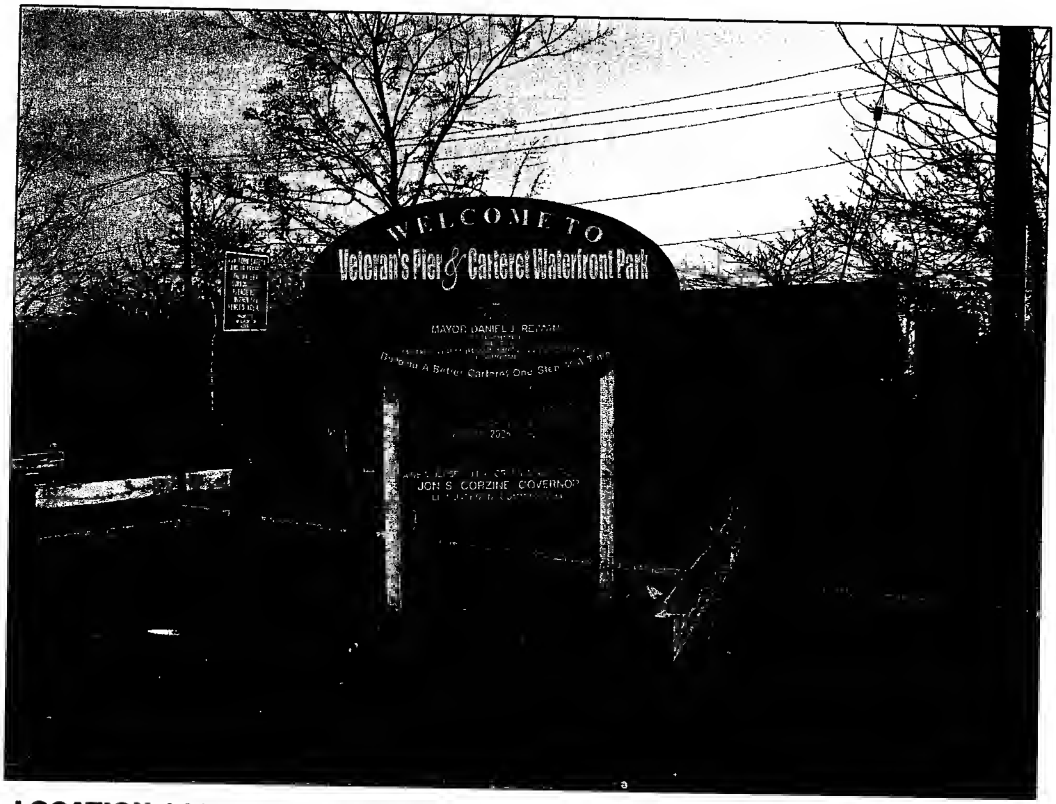
LOCATION 13-PHOTO 2: CARTERET WATERFRONT PARK DANIELLE'S GARDEN PEDESTRIAN WALKWAY LOCATED ADJACENT TO FORMER USMR FACILITY PROPERTY FENCE LINE (04/23/2008).

CH2MHILL

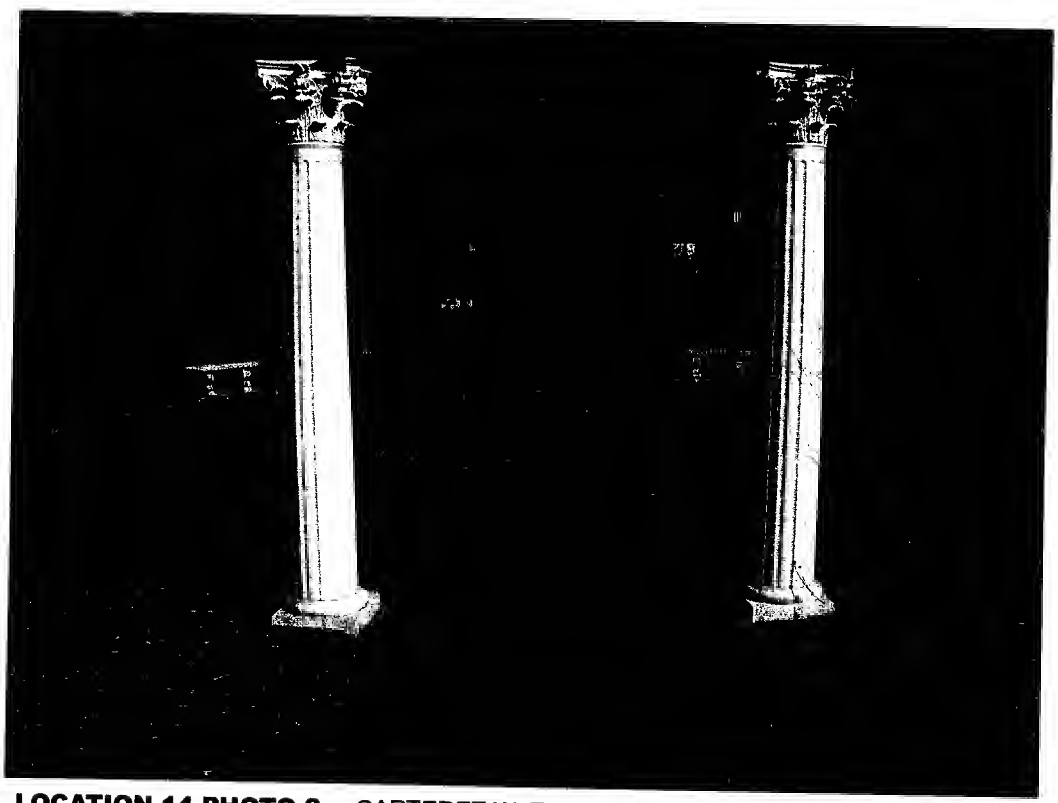


LOCATION 13-PHOTO 3: CARTERET WATERFRONT PARK DANIELLE'S GARDEN PEDESTRIAN WALKWAY ADJACENT TO FORMER USMR FACILITY PROPERTY LOOKING EAST TOWARD ARTHUR KILL. NOTE FORMER USMR FACILITY PROPERTY TO RIGHT (04/23/2008).

LOCATION 13-PHOTO 4: ARTHUR KILL SHORELINE BEACH ADJACENT TO FORMER USMR FACILITY PROPERTY LOOKING NORTH ACROSS TIDAL FLAT TOWARD VETERANS MEMORIAL PIER AND CARTERET WATERFRONT PARK (04/23/2008).



LOCATION 14-PHOTO 1: CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS PEDESTRIAN WALKWAY. NOTE 8-FOOT CHAINLINK FENCE AND FORMER USMR FACILITY PROPERTY ON OTHER SIDE OF FENCE (04/23/2008).



LOCATION 14-PHOTO 2: CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS PEDESTRIAN WALKWAY LOCATED ADJACENT TO FORMER USMR FACILITY PROPERTY AND FENCE LINE (04/23/2008).

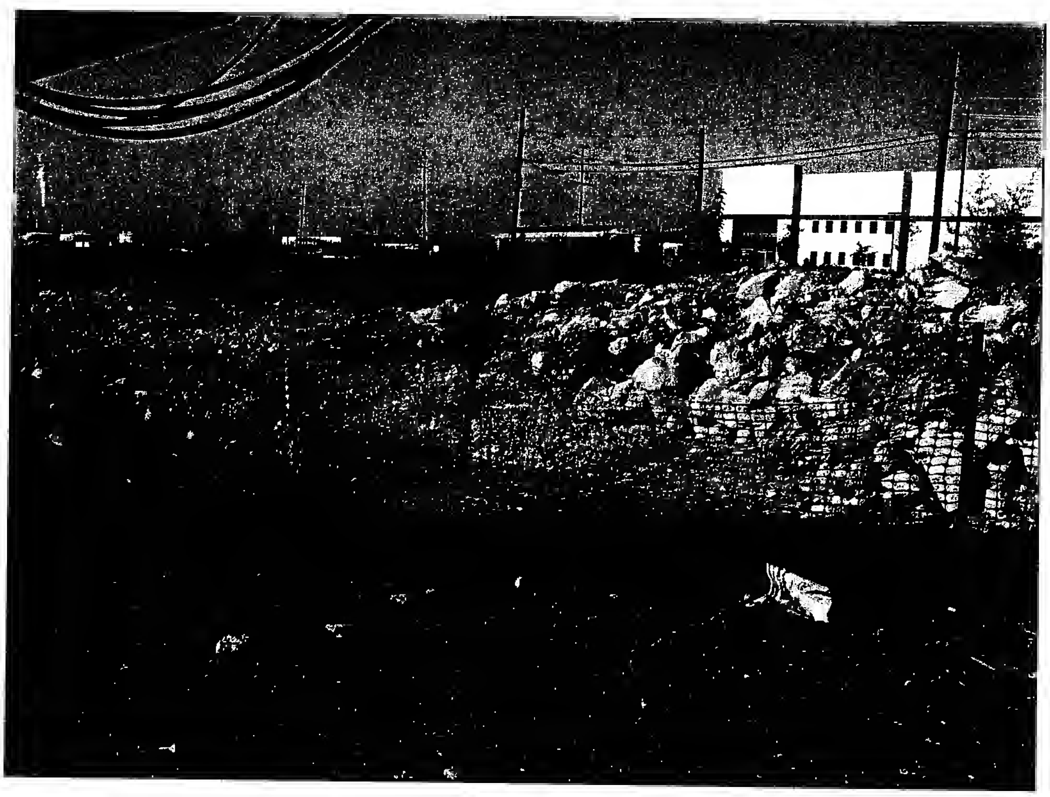
LOCATION 14-PHOTO 3: CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS PEDESTRIAN WALKWAY LOOKING THROUGH CHAINLINK FENCE AT LARGE PIECE OF SLAG ON FORMER USMR FACILITY PROPERTY (04/23/2008).

LOCATION 14-PHOTO 4: CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS PEDESTRIAN WALKWAY LOOKING THROUGH CHAINLINK FENCE AT LARGE PIECE OF SLAG ON FORMER USMR FACILITY PROPERTY (04/23/2008).

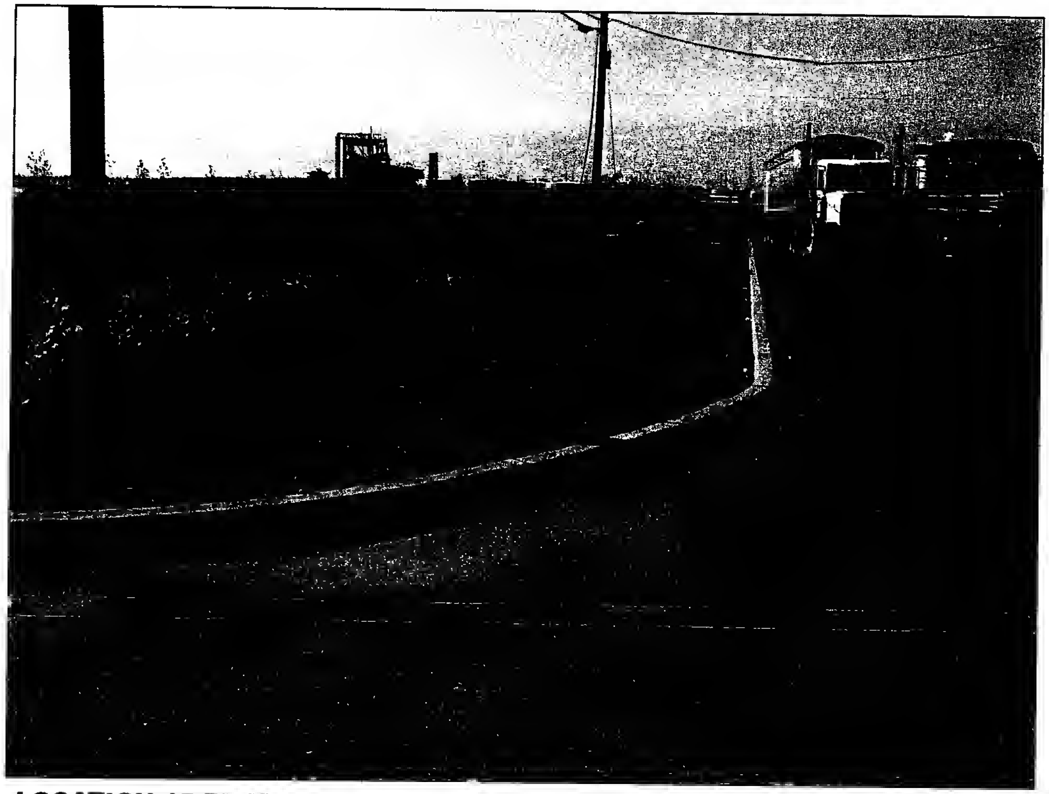
LOCATION 14-PHOTO 5: CLOSE-UP OF LARGE PIECE OF SLAG LOCATED ON FORMER USMR FACILITY PROPERTY NEXT TO CHAINLINK FENCE AT CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS WALKWAY (04/23/2008).

LOCATION 14-PHOTO 6: CLOSE-UP OF LARGE (GREATER THAN 3-FOOT DIAMETER) PIECE OF SLAG LOCATED ON FORMER USMR FACILITY PROPERTY NEXT TO CHAINLINK FENCE AT CARTERET WATERFRONT PARK DANIELLE'S GARDEN HANDICAPPED ACCESS WALKWAY (04/23/2008).

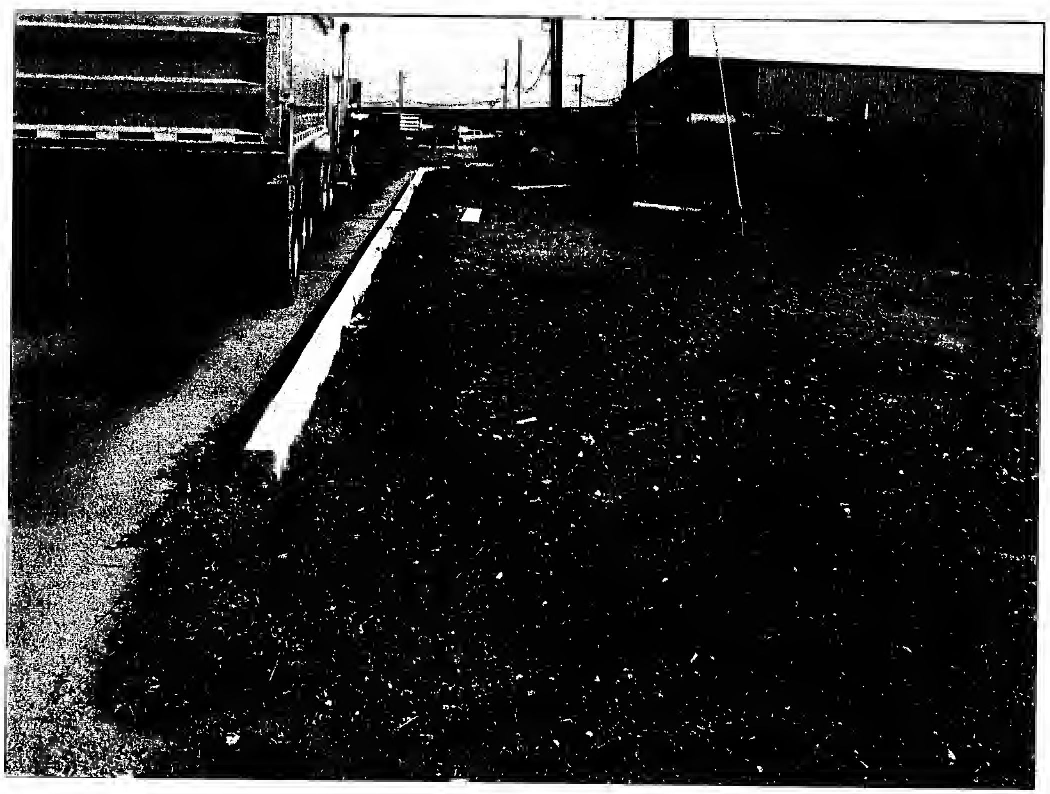
LOCATION 15-PHOTO 1: DEMOLITION OF THE FORMER LEAD PLANT BUILDING NO. 401 IN 2006. NOTE LOCATION OF FORMER 401 BUILDING AND RAILROAD LOADING DOCKS AS WELL AS THEIR PROXIMITY TO ROADWAY AND CURBING.



LOCATION 15-PHOTO 2: DEMOLITION DEBRIS FROM THE FORMER LEAD PLANT BUILDING NO. 401 RAILROAD LOADING DOCK. NOTE BLACK SLAG MATERIAL AMONG CONCRETE DEBRIS AND IN FOREGROUND. SAMPLE COLLECTED (JUNE 2008).



LOCATION 15-PHOTO 3: LOCATION OF THE FORMER LEAD PLANT BUILDING NO. 401 RAILROAD LOADING DOCK. NOTE BLACK SLAG MATERIAL IN FOREGROUND. SAMPLE COLLECTED (JUNE 2008).



LOCATION 15-PHOTO 4: LOCATION OF THE FORMER LEAD PLANT BUILDING NO. 401 RAILROAD LOADING DOCK. NOTE BLACK SLAG MATERIAL IN FOREGROUND. SAMPLE COLLECTED (JUNE 2008).

CH2MHILL

REICHHOLD, INC
Former Carteret, NJ Facility
US Metals Surficial Slag Photo Location Figure

Legend

N

Picture Location and Direction

4 Picture No.

CH2MHILL

PHOTOGRAPHIC LOG

Client Name: Reichhold, Inc.	Site Location: US Metals Carteret, New Jersey	Project Number: 353959.LI

Photo No.	Date:
1	05/15/07

Description: US Metals monitoring well near Reichhold property border adjacent to the Arthur Kill showing coarse, black slag at ground surface.

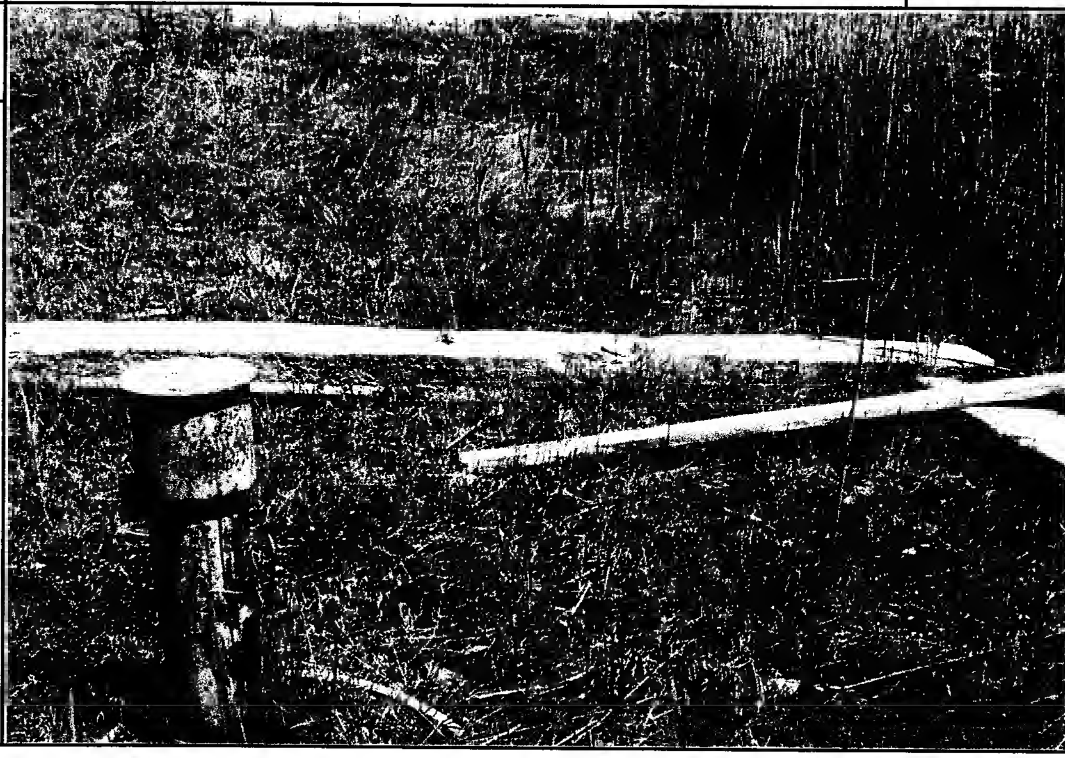
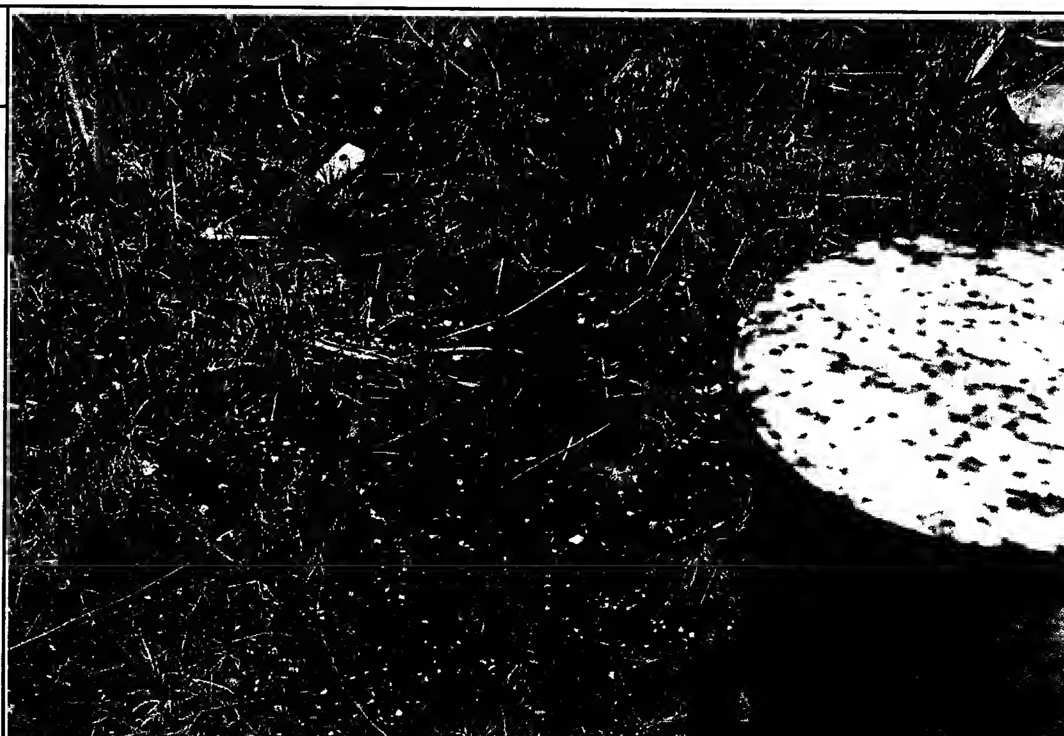


Photo No.	Date:
2	05/15/07

Description: Close-up of Photo No. 1 showing coarse, black slag at ground surface.



CH2MHILL

PHOTOGRAPHIC LOG

Client Name: Reichhold, Inc.	Site Location: US Metals Carteret, New Jersey	Project Number: 353959.LI

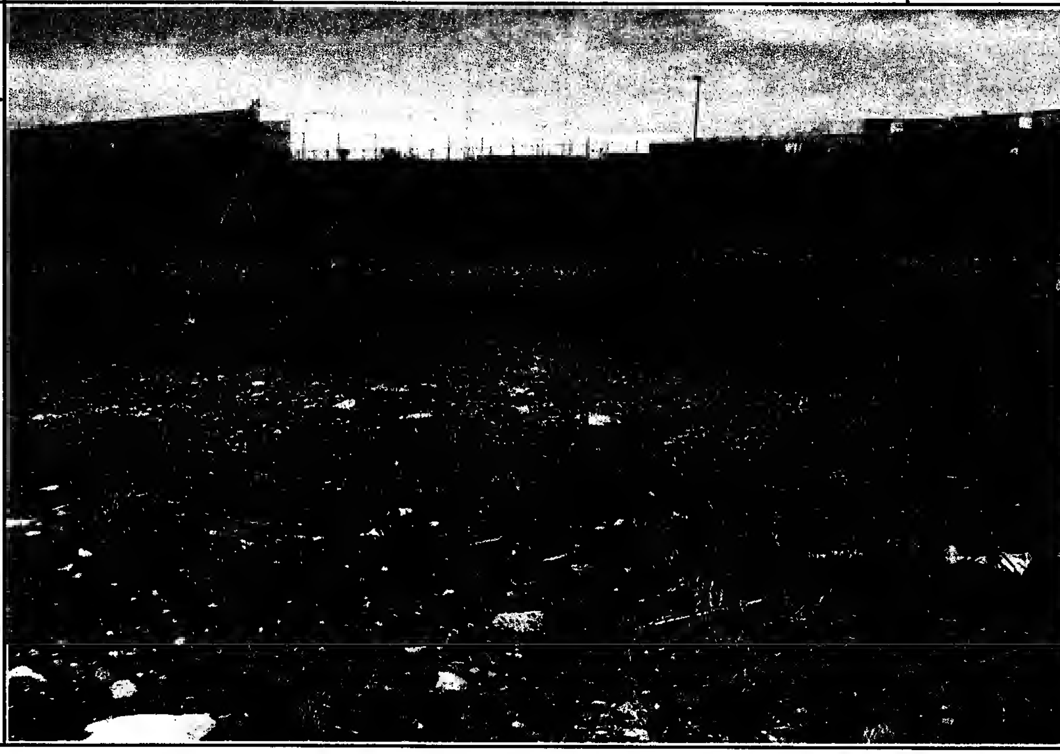
Photo No.	Date:	
3	05/15/07	
Description: Looking South-Southwest towards back of White Rose Distribution showing coarse, black slag at ground surface.		

Photo No.	Date:	
4	05/15/07	
Description: Looking West towards back of White Rose Distribution showing coarse, black slag and amorphous slag material at ground surface.		

CH2MHILL

PHOTOGRAPHIC LOG

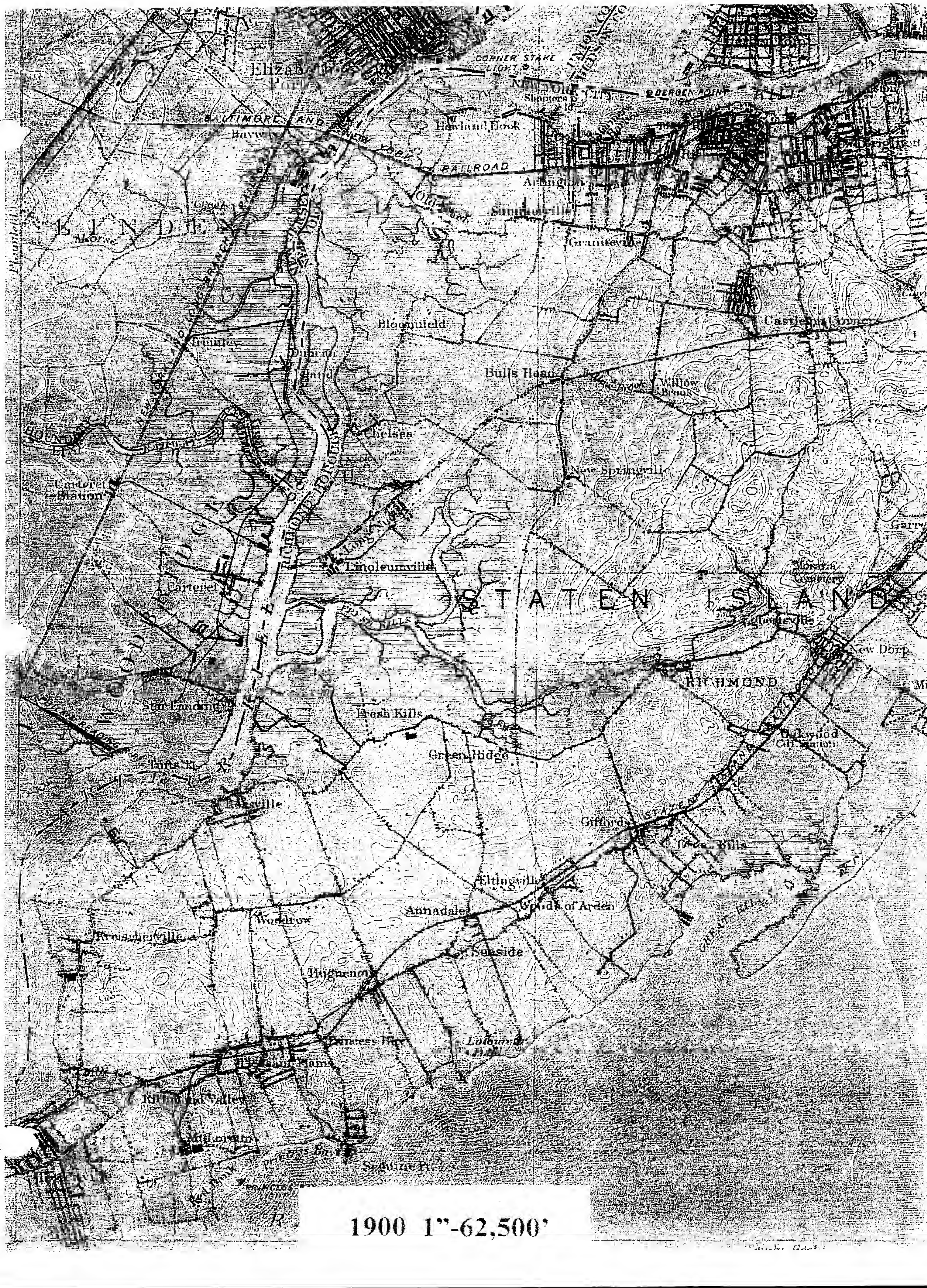
Client Name: Reichhold, Inc.	Site Location: US Metals Carteret, New Jersey	Project Number: 353959.LI

Photo No.	Date:
5	05/15/07

Description: Looking North towards Staten Island showing coarse, black slag and amorphous slag material in wetlands at ground surface.

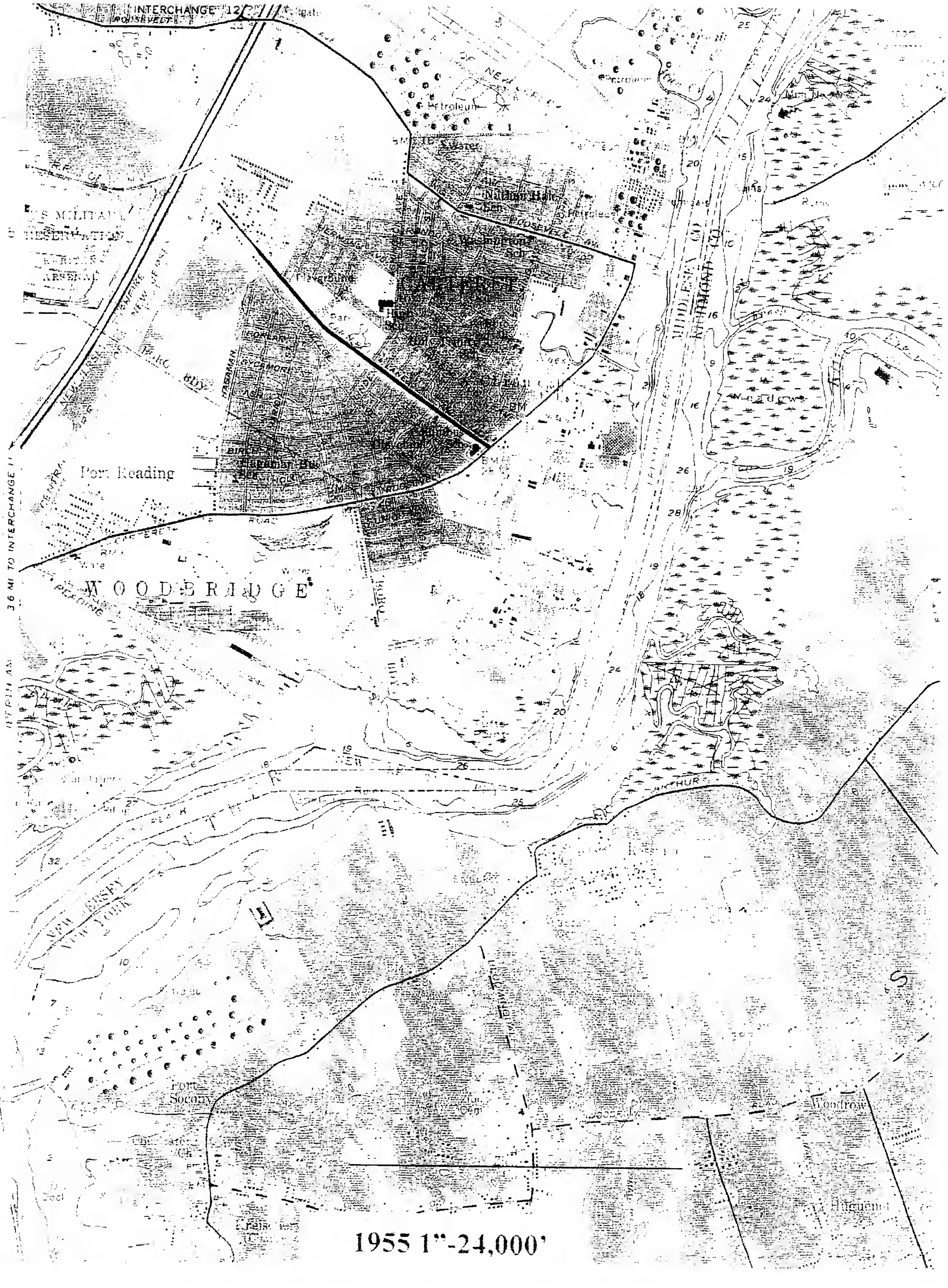
Appendix D

Topographic Maps

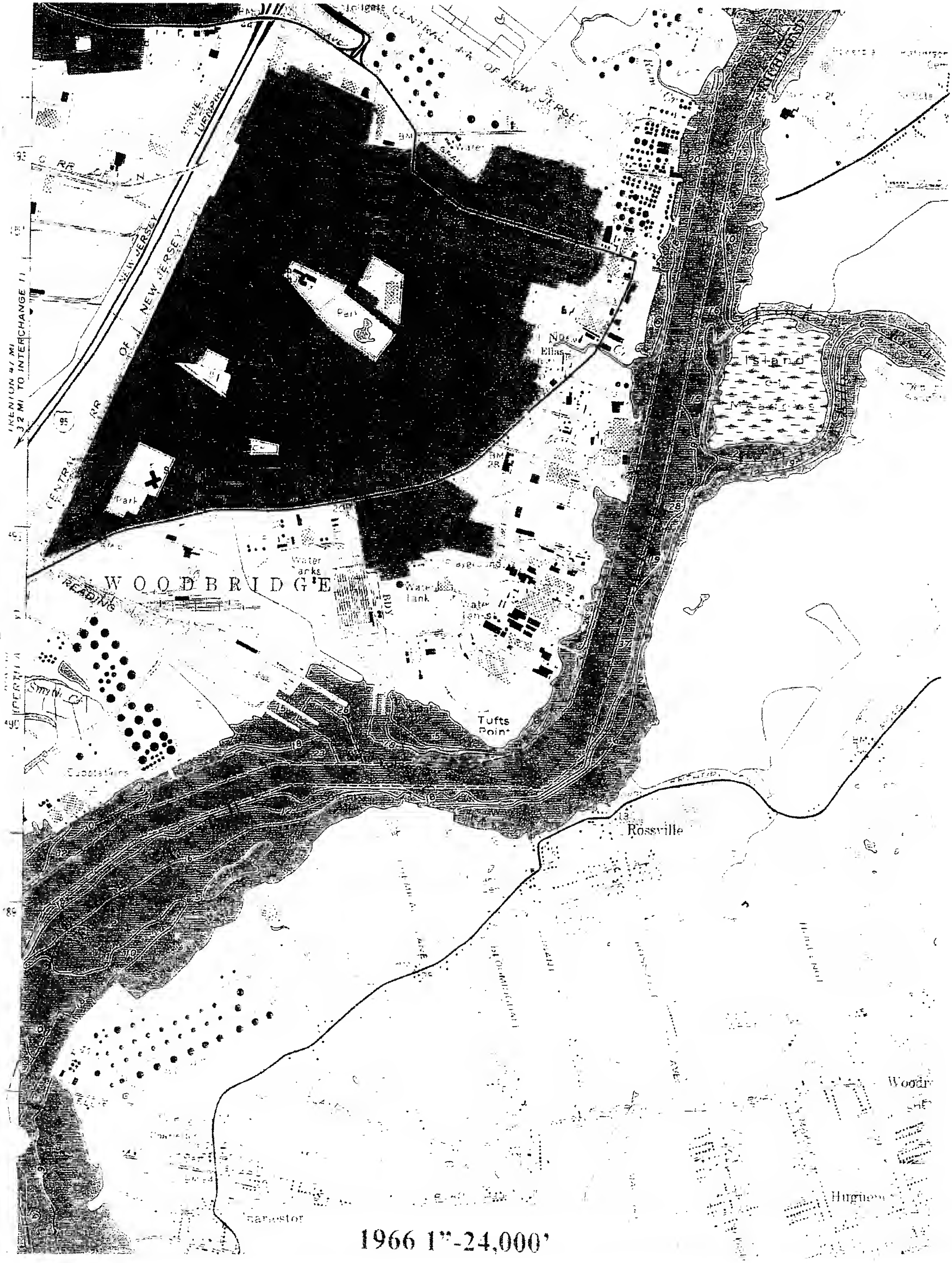


Elizabeth
BALTIMORE AND NEW YORK RAILROAD
CORNER STAKE LIGHT
Howland Hook
Arlington
Summerville
Graniteville
Bloomfield
Bulls Head
Willow Brook
Castleton Corners
Chelsea
New Springville
Carteret Station
Linoleumville
Carteret
STATEN ISLAND
New Dorp
RICHMOND
Fresh Kills
Green Ridge
Oakwood
Giffords
Eltingville
Annadale
Woods of Arden
Woodrow
Kreischerville
Seaside
Huguenot
Princess Bay
Richmond Valley
Seguine Pt.

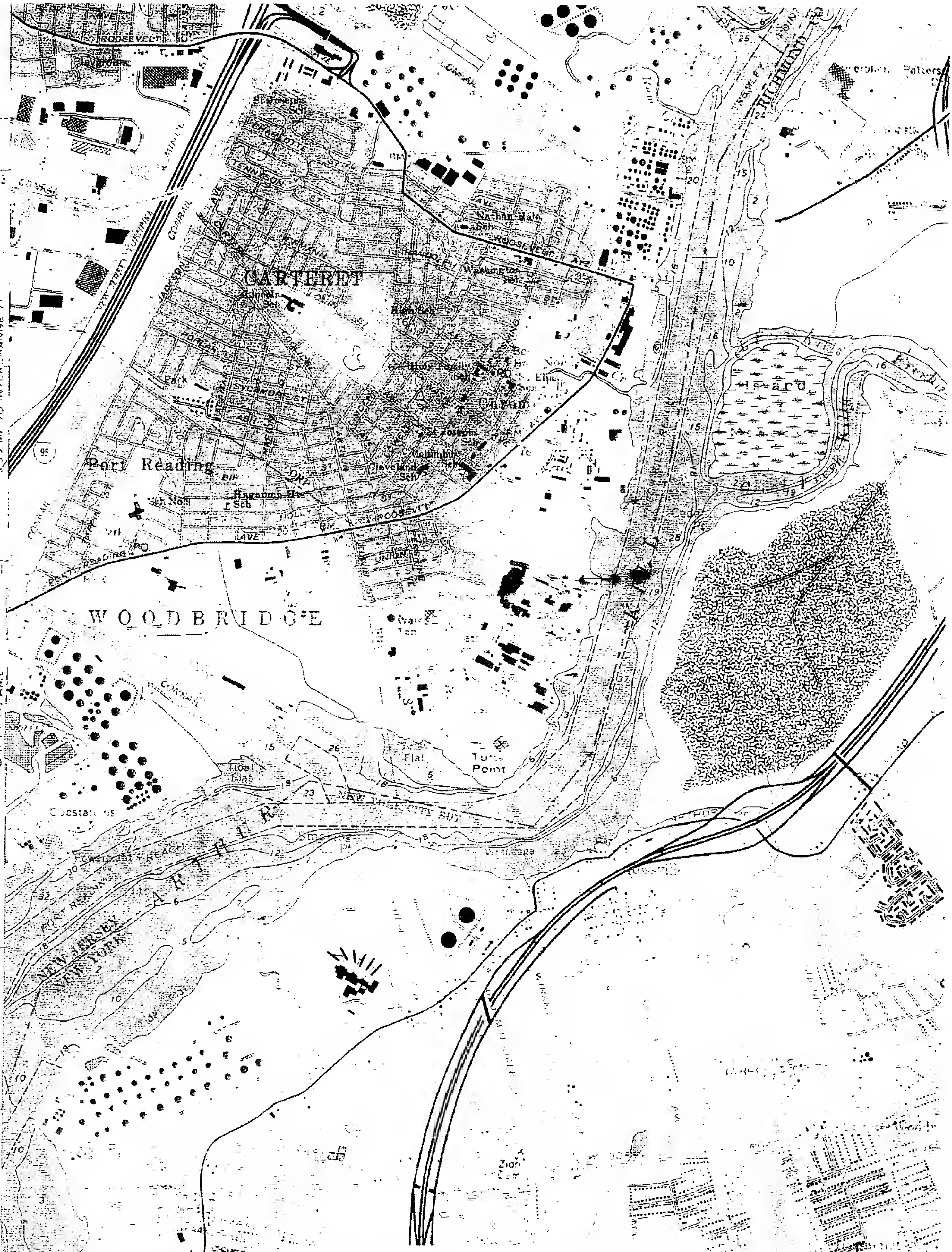
1900 1"-62,500'


INTERCHANGE 12
ROOSEVELT
Petroleum
Nathan Hale Sch
Washington Sch
CARTERET
Port Reading
WOODBRIDGE
MIDDLESEX CO
RICHMOND CO
ARTHUR KILL
NEW JERSEY
NEW YORK
Port Socony
Woodrow
Huguenot
3.6 MI TO INTERCHANGE 11

1955 1"-24,000'


WOODBRIDGE
NEW JERSEY TURNPIKE
CENTRAL RR OF NEW JERSEY
READING
Island of Meadows
Tufts Point
Rossville
Water Tanks
Water Tank
Park
Woodr
Hugueno

1966 1"-24,000'


CARTERET
WOODBRIDGE
Port Reading
ROOSEVELT AVE
ROOSEVELT
Playground
Park
TENNYSON
SYCAMORE ST
Lincoln Sch
High Sch
Washington Sch
Nathan Hale Sch
Cleveland Sch
Columbus Sch
Hagaman Hts Sch
St Joseph Sch
Holy Family Sch
CONRAIL
RICHMOND
Tidal Flat
Turn Point
NEW YORK CITY BDY
ARTHUR
NEW JERSEY
NEW YORK
Zion

1981 1"=24,000'

Appendix E

NJDEP Administrative Consent Order, 1988

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF HAZARDOUS WASTE MANAGEMENT

John J. Trela, Ph.D., Director
401 East State St.
CN 028
Trenton, N.J. 08625
609 - 633 - 1408

IN THE MATTER OF AMAX, INC., AMAX COPPER, INC., U.S. METALS REFINING COMPANY, AMAX REALTY DEVELOPMENT, INC., AND ACCREDITED LABS, INC.	ADMINISTRATIVE CONSENT ORDER

This Administrative Consent Order is entered into pursuant to the authority vested in the Commissioner of the New Jersey Department of Environmental Protection (hereinafter "NJDEP" or the "Department") by N.J.S.A. 13:1D-1 et seq. and the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., and the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq. and duly delegated to the Assistant Director of the Division of Hazardous Waste Management pursuant to N.J.S.A. 13:1B-4.

FINDINGS

1. AMAX, Inc. a New York Corporation with principal corporate offices located in Greenwich, Connecticut, is a company involved in mineral and energy development.

2. AMAX Copper, Inc., a Division of AMAX, Inc., is a Delaware Corporation with principal corporate offices located in Greenwich, Connecticut. AMAX Copper, Inc. owned and operated a copper smelter and precious metals refinery located at 400 Middlesex Avenue, Borough of Carteret (Block 3, Lots 2.2, 2.23 and 4, Block 2, Lots 2, 3, and 4) County of Middlesex, State of New Jersey (hereinafter the "facility" or the "site").

3. AMAX Realty Development Inc., a wholly owned subsidiary of AMAX, Inc., is a Delaware Corporation with its principal corporate offices located in Carteret, New Jersey.

4. U.S. Metals Refining Company, a former New Jersey corporation, owned and operated the above described refinery from approximately 1901 until April 25, 1983 when it merged into AMAX Copper, Inc.

5. Accredited Labs, Inc., a wholly owned subsidiary of AMAX,

ground water quality criteria of N.J.A.C. 7:9-6.1. In addition, AMAX contends that a different type of analysis using distilled water would more accurately define leaching from the slag to ground water.

13. The heavy metals described in paragraphs eight (8) and twelve (12) above are hazardous substances under the regulations at N.J.A.C. 7:1E-1 et seq. promulgated pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq.

14. In December of 1986, AMAX announced plans for the remediation and re-development of the 160 acre site. AMAX entered into a joint venture with V. Paulis and Associates, a New Jersey engineering and construction firm, for the purposes of carrying out the re-development. AMAX's re-development plans included demolition of buildings and remediation of the property, a proposal for a deep water port, fourteen warehouse buildings with two million square feet of storage and a public marina with a capacity for 550 boats.

15. On December 15, 1986 AMAX submitted a proposal for the demolition of buildings located at the north end of the facility. This demolition plan is part of the initial phases of the proposed re-development of the site. After inspections on January 14, 1987, March 17, 1987, June 30, 1987 and September 1, 1987 by Department personnel, approval letters were issued on January 21, 1987, March 31, 1987, July 10, 1987 and September 11, 1987 for the demolition of certain buildings on the site.

16. On March 3, 1987, AMAX submitted a draft "Report on Overview of Site Ground Water Investigations". This report on the hydrogeological work completed to date at the site fulfills much of the requirements of the remedial investigation contained in this Administrative Consent Order.

17. On September 24, 1987 the United States Environmental Protection Agency (EPA) completed the "National Dioxin Study Report". As part of the study, combustion sources including the AMAX facility (secondary copper smelter) were stack tested for dioxins and furans. Chapter Four (Tier Four) of the report which details the results of combustion source testing, reveals that during copper smelting operations, the AMAX facility was a source of dioxin and furan emissions. The "Preliminary Estimation of Public Health Risks" conducted by EPA's Office of Air Quality Planning and Standards, dated December, 1985, indicates that these emissions did not pose a significant threat to public health. Analyses of a composite soil sample collected during the Tier Four study from ten locations on the AMAX site revealed the presence of dioxins and furans. An initial assessment conducted by EPA Region II's Emergency and Remedial Response Division, in consultation with the Center for Disease Control, indicated that the soil sampling data did not exceed EPA action levels for emergency response.

18. Based on the facts set forth in this FINDINGS section, the Department alleges that AMAX has discharged hazardous substances and pollutants onto the land and into the waters of the state in violation of the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.,

investigation in accordance with the approved RI Work Plan and the schedule therein.

24. AMAX shall submit to the Department a draft Phase II Remedial Investigation Report (hereinafter "Phase II RI Report") in accordance with Appendix A and based on the RI Work Plan and the schedule therein.

25. If upon review of the draft Phase II RI Report the Department determines that an additional remedial investigation is required, AMAX shall conduct additional remedial investigation as directed by the Department and submit a third ~~draft~~ RI Report.
Phase [illegible]

26. Within thirty (30) calendar days after receipt of the Department's written comments on the Phase II draft or third draft (if applicable pursuant to the preceding paragraph) RI Report, AMAX shall modify the Phase II draft or third draft RI Report to conform to the Department's comments and shall submit the modified RI Report to the Department. The determination as to whether or not the modified RI Report, as resubmitted, conforms with the Department's comments shall be made solely by the Department.

B. Feasibility Study

27. Within thirty (30) calendar days after receipt of the Department's written final approval of the RI Report, or as otherwise directed by the Department, AMAX shall submit to the Department a draft Feasibility Study Work Plan (hereinafter, "FS Work Plan") for the entire site in accordance with the scope of work set forth in Appendix D which is attached hereto and made a part hereof. In the FS Work Plan, AMAX may make reference to the identification of operable units and a phased remedial approach in accorance with Appendix D. II. E. 8. Operable unit is defined as a specific area or medium.

28. Within thirty (30) calendar days after receipt of the Department's written comments on the draft FS Work Plan, AMAX shall modify the draft FS Work Plan to conform to the Department's comments and shall submit the modified FS Work Plan to the Department. The determination as to whether or not the modified FS Work Plan, as resubmitted, conforms to the Department's comments shall be made solely by the Department.

29. Upon receipt of the Department's written final approval of the FS Work Plan, AMAX shall conduct the feasibility study(s) in accordance with the approved FS Work Plan and the schedule therein.

30. AMAX shall submit to the Department a draft Feasibility Study Report(s) (hereinafter "FS Report") in accordance with Appendix D and the approved FS Work Plan and the schedule therein.

31. Within thirty (30) calendar days after receipt of the Department's written comments on the draft FS Report(s), AMAX shall modify the draft FS Report(s) to conform to the Department's comments and shall submit the modified FS Report(s) to the Department. The determination as to whether or not the modified FS Report(s), as

c. Identify specific requirements of this Administrative Consent Order (including the corresponding paragraph reference or schedule) which were initiated in a previous reporting period, which are still in progress and which will continue to be carried out during the next reporting period.

d. Identify specific requirements of this Administrative Consent Order (including the corresponding paragraph reference or schedule) completed during this reporting period.

e. Non-compliance: Identify specific requirements of this Administrative Consent Order (including the corresponding paragraph reference or schedule) which should have been completed during this reporting period and were not.

f. An explanation of any non-compliance with this Administrative Consent Order and/or the approved work plan(s), Remedial Action Plan or schedule(s).

g. Identify the specific requirements of this Administrative Consent Order (including the corresponding paragraph reference or schedule) which will be initiated during the upcoming reporting period.

II. <u>Permits</u>

38. Within ninety (90) calendar days after the effective date of this Administrative Consent Order, AMAX shall apply for all necessary Federal, State and local permits for existing activities and, where applicable, former activities, in accordance with the requirements of N.J.A.C. 7:14A-1 et seq., N.J.A.C. 7:26-1 et seq., and N.J.A.C. 7:27-8, and other applicable statutes and regulations.

39. AMAX shall submit complete and sufficient applications for all Federal, State and local permits required to carry out the obligations of this Administrative Consent Order in accordance with the preceding paragraph and the approved time schedules.

40. Within twenty-eight (28) calendar days of receipt of written comments concerning any permit application to a Federal, State or local agency, or sooner if required by the permitting agency, AMAX shall modify the permit application to conform to the agency's comments, correct any deficiencies by submitting additional data or information that is required by the permit application, and resubmit the permit application to the agency. The determination as to whether or not the permit application, as resubmitted, conforms with the agency's comments and is complete, shall be made solely by the agency.

41. This Administrative Consent Order shall not relieve AMAX from obtaining and complying with all applicable Federal, State and local Permits, as well as all applicable statutes and regulations while carrying out the obligations imposed by this Administrative Consent Order.

Department a proposed irrevocable letter of credit which meets the following requirements:

a. Is identical to the wording specified in Appendix F which is attached hereto and made a part hereof;

b. Is issued for one year and in the event that the issuing bank or financial institution is subject to Title 17 of the Revised Statutes of New Jersey, shall not be automatically renewable but shall be renewable upon reapplication and review only;

c. Is issued by a New Jersey State or Federally chartered bank, savings bank, or savings and loan association, which has its principal office in New Jersey, unless otherwise approved by the Department.

48. Within twenty-one (21) calendar days after the effective date of this Administrative Consent Order, AMAX shall submit to the Department a proposed irrevocable standby trust fund agreement which meets the following requirements:

a. Is identical to the wording specified in Appendix H which is attached hereto and made a part hereof;

b. The irrevocable standby trust fund shall be the depository for all funds paid pursuant to a draft by the Department against the letter of credit;

c. The trustee shall be an entity which has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or New Jersey agency;

d. Is accompanied by a certification of acknowledgement that is identical to the wording specified in Appendix G.

49. Within fourteen (14) calendar days after receipt of the Department's written comments on the proposed letter of credit, the proposed trust agreement, and the proposed certification of acknowledgement, AMAX shall modify the documents to conform to the Department's comments and resubmit them to the Department.

50. Within fourteen (14) calendar days after receipt of the Department's written approval of the letter of credit, the trust agreement, and the certification of acknowledgement, AMAX shall:

a. Obtain and provide to the Department the irrevocable letter of credit in the amount of $3,000,000;

b. Establish the irrevocable standby trust fund and deposit an initial amount of $1,000 into the irrevocable standby trust fund; and

connection with its oversight functions of this Administrative Consent Order for a fiscal year, or any part thereof, AMAX shall submit to the Department a cashier's check or certified check payable to the "Treasurer, State of New Jersey" for the full amount of the Department's oversight costs (not to exceed $100,000 per year).

D. <u>Stipulated Penalties</u>

57. AMAX shall pay stipulated penalties to the Department for its failure to comply with any of the deadlines and schedules required by this Administrative Consent Order including those established and formally approved by the Department pursuant to the terms of this Administrative Consent Order. Payment of stipulated penalties shall be made according to the following schedule, unless the Department has modified the compliance date pursuant to the force majeure provisions hereinbelow:

Calendar Days After Due Date	Stipulated Penalties
1 - 7	$ 500 per calendar day
8 - 14	$ 1,000 per calendar day
15 - 21	$ 2,500 per calendar day
22 - 28	$ 5,000 per calendar day
29 - over	$10,000 per calendar day

58. Any such penalty shall be due and payable fourteen (14) calendar days following receipt of a written demand by the Department. Payment of such stipulated penalties shall be made by cashier's or certified check payable to the "Treasurer, State of New Jersey". Each payment of a stipulated penalty shall include a letter describing the basis for the penalty.

V. <u>Force Majeure</u>

59. If any event occurs which AMAX believes will or may cause delay in the achievement of any provision of this Administrative Consent Order, AMAX shall notify the Department in writing within seven (7) calendar days of the delay or anticipated delay, as appropriate, referencing this paragraph and describing the anticipated length of the delay, the precise cause or causes of the delay, any measures taken or to be taken to minimize the delay, and the time required to take any such measures to minimize the delay. AMAX shall take all necessary action to prevent or minimize any such delay.

60. If the Department finds that: (a) AMAX has complied with the notice requirements of the preceding paragraph and; (b) that any delay or anticipated delay has been or will be caused by fire, flood, riot, strike or other circumstances beyond the control of AMAX, the Department shall extend the time for performance hereunder for a period no longer than the delay resulting from such circumstances. If the Department determines that either AMAX has not complied with the notice requirements of the preceding paragraph, or the event causing the delay is not beyond the control of AMAX, failure to comply with the

69. AMAX shall preserve, during the pendency of this Administrative Consent Order and for a minimum of six (6) years after its termination, all data, records and documents in original or facsimile form in their possession or in the possession of their divisions, employees, agents, accountants, contractors, or attorneys which relate in any way to the implementation of work under this Administrative Consent Order, despite any document retention policy to the contrary. After this six year period, AMAX shall notify the Department within twenty-eight (28) days prior to the destruction of any such documents. If the Department requests in writing that some or all of the documents be preserved for a longer time period, AMAX shall comply with that request. Upon request by the Department, AMAX shall make available to the Department such records or copies of any such records which are not subject to the attorney/client privilege.

70. No obligations imposed by this Administrative Consent Order (with the exception of paragraphs fifty-seven (57) and fifty-eight (58) are intended to constitute a debt, claim, penalty or other civil action which should be limited or discharged in a bankruptcy proceeding. All obligations imposed by this Administrative Consent Order shall constitute continuing regulatory obligations imposed pursuant to the police powers of the State of New Jersey intended to protect human health or the environment.

71. In addition to the Department's statutory and regulatory rights to enter and inspect, AMAX shall allow the Department and its authorized representatives access to the site upon reasonable notice at all times for the purpose of monitoring AMAX's compliance with this Administrative Consent Order.

72. The Department reserves the right to require AMAX to take additional actions should the Department determine that such actions are necessary to protect human health or the environment. Nothing in this Administrative Consent Order shall constitute a waiver of any statutory right of the Department pertaining to any of the laws of the State of New Jersey should the Department determine that such measures are necessary.

73. AMAX shall not construe any informal advice, guidance, suggestions, or comments by the Department, or by persons acting on behalf of the Department, as relieving AMAX of its obligation to obtain written approvals as may be required herein, unless such advice, guidance, suggestions, or comments by the Department shall be submitted in writing to AMAX.

74. No modification or waiver of this Administrative Consent Order shall be valid except by written amendment to this Administrative Consent Order duly executed by AMAX and the Department.

75. AMAX hereby consents to and agrees to comply with this Administrative Consent Order which shall be fully enforceable as an Order in the New Jersey Superior Court upon the filing of a summary action for compliance pursuant to N.J.S.A. 13:1D-1 et seq., the

LIST OF APPENDICES

REMEDIAL INVESTIGATION SCOPE OF WORK

I. Requirements of Remedial Investigation

A. Fully characterize all waste and other materials which are, or may be the source(s) of pollution at the site

B. Fully determine the nature, type and physical states of soil, surface water and ground-water pollution at and/or emanating from the site

C. Fully determine the horizontal and vertical extent of pollution at and/or emanating from the site

D. Fully determine migration paths of pollutants through air, soil, ground water, surface water and sediment

E. Fully determine impact of the pollution on human health and the environment

F. Collect, present and discuss all data necessary to adequately support the development of a feasibility study and the selection of a remedial action alternative that will remediate the adverse impacts of the pollution on human health and the environment

II. Contents of Remedial Investigation Work Plan for Work Plans to be Submitted

IMPORTANT NOTE: All of the following items shall be included in the RI Work Plan. If any of the items have previously been submitted or completed, it shall be so stated in the RI Work Plan. For these items, the following shall be included in the RI Work Plan:

- description of items submitted and/or summary of investigation completed
- date(s) of submission or completion
- any known changes or new information developed since submission or completion

The Department will determine the extent to which prior submissions or completions may satisfy specific items required by this Scope of Work.

A. A statement of requirements for the remedial investigation pursuant to Section I., above

B. A complete site history including:

d. specify EPA analytical procedures, including test parameters for waste analyses

e. specify chain-of-custody procedures

f. specify the name of the State certified laboratory AMAX will use for analysis of all samples

g. specify when Tier I [and Tier II] quality assurance deliverable requirements will be submitted in accordance with Appendix C, which is attached hereto and made a part hereof

h. specify Federal, State and local permits required

i. specify investigation procedures in accordance with the following:

   i. obtain drilling permits for all soil borings pursuant to N.J.A.C. 58:4A-14

   ii. install soil borings under direct supervision of a New Jersey licensed well driller and a qualified geologist

   iii. decontaminate soil boring and sampling equipment between individual samples and borings according to the approved decontamination plan

   iv. classify waste according to N.J.A.C. 7:26-1 et seq.

   v. use field instrumentation (PID, FID) to analyze soil samples in the field

   vi. analyze waste samples to quantify and determine type of pollutants

   vii. permanently seal all soil borings using a certified well sealer

2. Soil investigation

   a. specify number, type and frequency of samples required to accurately define the horizontal and vertical extent of soil pollution at and/or emanating from the site

   b. explain the type of data which will be collected, justification for collection and intentions for use of the data

USMR 002490

a. specify number, locations (on site map) and designs of existing and proposed piezometers, monitor wells, and other sampling points required to accurately define the horizontal and vertical extent of ground-water pollution at and/or emanating from the site

b. explain the type of data which will be collected, justification for collection, and intentions for use of the data

c. specify number, type and frequency of ground-water and potable well samples required to accurately define the horizontal and vertical extent of ground-water pollution at and/or emanating from the site

d. specify EPA analytical procedures, including test parameters for ground-water analyses

e. specify chain-of-custody procedures

f. specify the name of the State certified laboratories AMAX will use for analysis of all samples

g. specify when Tier I [and Tier II] quality assurance deliverable requirements will be submitted in accordance with Appendix C

h. specify frequency of synoptic static water level measurements

i. specify all Federal, State and local permits required

j. specify investigation procedures in accordance with the following

   i. have a qualified hydrogeologist with substantial experience in ground-water pollution investigations oversee all site activities

   ii. obtain well drilling permits pursuant to N.J.S.A. 58:4A-14

   iii. drill all wells under the direct supervision of a New Jersey licensed well driller and a qualified hydrogeologist

   iv. install wells in accordance with the monitor well specifications in Appendix D, which is attached hereto and made a part hereof

viii. decontaminate drilling and sampling equipment after each drilling and sampling event according to the approved decontamination plan

ix. survey all well casings, to the nearest hundredth (0.01) foot above mean sea level and horizontally to an accuracy of one-tenth of a second latitude and longitude by a New Jersey licensed land surveyor

x. obtain synoptic static water levels to the nearest hundredth (0.01) foot in each monitor well

xi. collect all ground-water samples pursuant to N.J.A.C. 7:14A-6.12

xii. well samples shall not be collected within 14 calendar days of installation and development of the wells

xiii. complete sufficient pumping and packer tests to adequately define aquifer characteristics

xiv. complete geophysical surveys and/or ground-water modeling as appropriate for the site

4. surface water and sediment investigation

a. specify number and type of samples required to accurately determine the horizontal and vertical extent of surface water and sediment pollution at and/or emanating from the site

b. explain the type of data which will be collected, justification for collection, and intentions for use of the data

c. specify location (on site map) of surface water and sediment sampling points

d. specify EPA analytical procedures, including test parameters, for surface water and sediment analyses

e. specify chain-of-custody procedures

f. specify the name of the State certified laboratory AMAX will use for analysis of all samples

g. specify when Tier I [and Tier II] quality assurance deliverable requirements will be submitted in accordance with Appendix C

and potential environmental impairment associated with the site investigation, including:

1. listing of personal protective equipment (including respiratory protection) to be used and guidelines for their use, including manufacturer, model, duration of safety period, and any required certification documentation

2. listing of safety equipment (including manufacturer, expiration date and model) to be used, such as fire extinguishers, portable eye wash stations, air monitoring equipment, gamma survey instrument, etc. (equipment shall meet OSHA standards or other acceptable industrial standards)

3. contingency plans for emergency procedures, spill prevention/response, and evacuation plans

4. on-site monitoring for personnel safety (e.g. PID, FID)

5. criteria for selecting proper level of personal protection

6. medical surveillance program for all on-site personnel involved in remedial investigation

7. personal hygiene requirements

8. training program including training protocol

9. special medical procedures to be available at site

10. telephone numbers of emergency medical facility and personnel

H. An equipment decontamination plan including:

1. list the items to be decontaminated

   a. drilling equipment, paying particular attention to down hole tools, back of drilling rig and drilling rod racks

   b. sampling equipment including split spoons, shelby tubes, trowels, spatulas, etc.

   c. bailers, pumps, hoses, etc.

   d. personnel clothing

2. procedures for decontamination

3. soil quality contour map and cross section(s)

4. ground-water elevation contour maps for each aquifer on multiple dates

5. ground-water quality contour map(s) and cross section(s)

6. bedrock contour map

C. Discussion of data

1. waste characterization, including degree of hazard and probable quantities of waste, by type

2. description of site/regional hydrogeology and its relation to migration of pollutants

3. direction and rate of ground-water flow in the aquifer(s), both horizontally and vertically

4. levels of soil, surface water and ground-water pollution as compared to applicable standards pursuant to N.J.A.C. 7:14A-1 et seq., 7:9-5, 7:9-6, and guidelines, or background levels where pertinent

5. extent of soil, surface water and ground-water pollution both on and off site

6. pollutant behavior, stability, biological and chemical degradation, mobility and any other relevant factors pertinent to the investigation

7. projected rate(s) of pollution movement

8. identification of all pollution sources

9. identification of critical pollutants

D. Assessment of impact of pollution on human health and the environment

1. identification of human receptors in the paths of pollution migration; mobility of pollutants and specific routes to target organs (e.g., liver)

2. identification of the receiving media and/or ecological groups and migration pathways of critical pollutants

3. toxicology of each critical pollutant (acute and chronic toxicity for short- and long-term exposure, carcinogenicity, mutagenicity, teratogenicity, synergistic and/or antagonistic associations, aquatic toxicity, ecological impacts on flora and fauna, etc.)

APPENDIX B

QUALITY ASSURANCE REQUIREMENTS

APPENDIX C

MONITOR WELL SPECIFICATIONS

3. The borehole must be a minimum of four (4) inches greater than the casing diameter.
4. Wells must be gravel packed unless noted otherwise in Additional Requirement #8.
5. Approved high grade sodium base, well sealant type, granular bentonite must be used to seal casing. Casing sealant and drilling fluids must be mixed with potable water. All wells must be developed upon completion for a minimum of one (1) hour or to yield a turbid-free discharge.
7. The driller must maintain an accurate written log of all materials encountered in each hole, record all construction details for each well, the static water levels, and any tidal fluctuations (when applicable). This information must be submitted to the Office of Water Allocation as required by N.J.S.A. 58:4A.
8. If low level organic compounds are to be sampled for, only threaded or press joints (no glue joints) are acceptable.
9. A length of steel casing with a locking cap must be securely set in cement a minimum of three (3) feet below ground surface.
10. Top of PVC casing (excluding cap) must be surveyed to the nearest hundreth foot (0.01) by a licensed surveyor. The casing must be permanently marked at the point surveyed. The well(s) should be numbered clearly on the casing. A detailed site map with the well locations and casing elevations must be submitted to ______________________________ ______________________________.

11. NOTICE IS HEREBY GIVEN OF THE FOLLOWING:

    a. Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules;
    b. The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable or other structure;
    c. The permittee (applicant) is solely responsible for safety and adequacy of the design and construction of wells required to be constructed by the Department;
    d. The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

ADDITIONAL REQUIREMENTS (IF CHECKED):

☐1. Top of screen set _____ feet above/below water table.

☐2. Split Spoon Samples ______________________________

☐3. Dedicated Bailer (Sampler) In Well(s) ______________________________

☐4. Threaded or Press Joints ______________________________

☐5. Five (5) Foot Casing Tailpiece Below Screen ______________________________

☐6. Centralizers On Screen ______________________________

☐7. Borehole Geophysical Log(s) ______________________________

☐8. Other ______________________________

____

* OTHER MATERIALS, DESIGNS AND CASING DIAMETERS MAY BE USED WITH PRIOR APPROVAL BY THE

3. Oversize borehole, minimum four (4) inches greater than casing diameter drilled through overburden and casing sealed ten (10) feet into competent rock unless shown otherwise above.
4. Approved high grade sodium base well sealant type, granular bentonite must be used to seal casing. Casing sealant and drilling fluids must be mixed with potable water.
5. Well must be developed upon completion for a minimum of one (1) hour or to yield a turbid-free discharge.
6. The driller must maintain an accurate written log of all materials encountered in each hole, record all construction details for each well, and record the depth of major water bearing fracture zones. This information must be submitted to the Office of Water Allocation as required by N.J.S.A. 58:4A.
7. Cement collar must be installed a minimum of one (1) hour after casing seal has been emplaced.
8. Locking caps must be provided to secure each well.
9. Top of each well casing (excluding cap) must be surveyed to the nearest hundreth foot (0.01) by a licensed surveyor. The casing must be permanently marked at the point surveyed. The well should be numbered clearly on the casing. A detailed site map with well locations and casing elevations must be submitted to ________ ____________________.

10. NOTICE IS HEREBY GIVEN OF THE FOLLOWING:

a. Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules;
b. The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable or other structures;
c. The permittee (applicant) is solely responsible for safety and adequacy of the design and construction of well required to be constructed by the Department;
d. The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

ADDITIONAL REQUIREMENTS (IF CHECKED):

☐ 1. Split Spoon Samples (In Overburden) ____________________

☐ 2. Rock Core Samples ____________________

☐ 3. Dedicated Bailer (Sampler) in Well(s) ____________________

☐ 4. Borehole Geophysical Log(s) ____________________

☐ 5. Other ____________________

____

* OTHER DRILLING METHODS, MATERIALS, DESIGNS AND CASING DIAMETERS MAY BE USED WITH PRIOR APPROVAL BY NJDEP.

11. describe which Federal, State and local permits would be necessary for each alternative identified and outline

the information necessary for the development of each of the permit applications

12. describe the time required for implementation, including significant interim dates

F. A detailed discussion of procedures to evaluate and compare the remedial action alternatives that remain after the initial screening in accordance with the following:

1. evaluate each alternative in accordance with the requirements referenced in I. D., above, and the following characteristics:

    i. level of cleanup achievable

    ii. time to achieve cleanup

    iii. feasibility

    iv. implementability

    v. reliability

    vi. ability to minimize adverse impacts during action

    vii. ability to minimize off-site impacts caused by action

    viii. useability of ground water after implementation of alternative

    ix. useability of surface water after implementationof alternative

    x. useability of site after implementation of alternative

    xi. legal constraints

2. compare each alternative in accordance with the requirements and characteristics identified in II. F. 1. above

G. Presentation of procedure concerning recommendation of remedial action alternative in accordance with the following:

1. based on the detailed evaluation process, recommend the most environmentally sound remedial action alternative which will, in the most timely manner, meet the requirements in I. D. above

APPENDIX E

REMEDIAL ACTION
SCOPE OF WORK

APPENDIX F

LETTER OF CREDIT WORDING

If AMAX does not renew the letter of credit by __________, 19__ (same date as proceeding paragraph), we shall advise you in writing no later than __________, 19__ (date to be inserted is 45 calendar days prior to expiration date of letter of credit) that AMAX has not reviewed the letter of credit.

If AMAX does not renew this letter of credit by __________, 19__, (60 calendar days prior to expiration) we will deposit the full amount of the letter of credit into the standby trust fund of AMAX no later than __________, 19__ (14 calendar days prior to expiration) and we will notify you in writing by __________, 19__ (7 calendar days prior to expiration) that we did in fact deposit the full amount of the letter of credit.

TRUST AGREEMENT

Trust Agreement, "Agreement", entered into as of ___(date)___ by and between AMAX known as "Grantor" and ___issuing institution___ the "Trustee".

Whereas, the New Jersey Department of Environmental Protection, "NJDEP", an agency of the State of New Jersey, has entered into an Administrative Consent Order with Grantor dated __________, 19__, a copy of which is annexed hereto as Schedule "A", pursuant to which Grantor is obligated to establish a trust fund to assure the availability of funds to secure the performance of Grantor's obligations under that Administrative Consent Order.

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this agreement, and the Trustee is willing to act as trustee.

Now, Therefore, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a) The term "Grantor" means ___AMAX___ who enters into this Agreement and any successors or assigns of the Grantor.

(b) The term "Trustee" means the Trustee who enters into the Agreement and any successor Trustee, who has the authority to act as a trustee and whose trust operations are regulated and examined by a Federal or New Jersey agency. The name, address, and title of the Trustee is:

____

____

____

(c) The term "Commissioner" means the Commissioner of the New Jersey Department of Environmental Protection.

(d) The term "Beneficiary" means the New Jersey Department of Environmental Protection.

(e) The term "NJDEP" means the New Jersey Department of Environmental Protection.

Section 2. Identification of Facilities and Cost Estimates. This Agreement pertains to the facilities and cost estimates identified on attached Schedule "A".

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a trust fund, the "Fund", for the benefit of NJDEP. The Grantor and the Trustee intend that no third party have access to

the Fund except as herein provided. The Fund is established initially as consisting of the property, which is acceptable to the Trustee,

competent jurisdiction for the appointment of a successor trustee or for instructions. The successor trustee shall specify the date on which it assumes administration of the trust in a writing sent to the Grantor, the NJDEP and the present Trustee by certified mail 10 calendar days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests and instructions by the Grantor to the Trustee shall be in writing, signed by such persons as are designated in the attached Schedule "C". The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests and instructions. All orders, requests, and instructions by the NJDEP to the Trustee shall be in writing, signed by the NJDEP Commissioner or his/her designee and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or NJDEP

hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests and instructions from the Grantor and/or NJDEP, except as provided for herein.

Section 15. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee and the NJDEP or by the Trustee and the NJDEP if the Grantor ceases to exist.

Section 16. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement, as provided in Section 15, this Trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee and the NJDEP or of the Trustee and the NJDEP, if the Grantor ceases to exist. Upon termination of the Trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor.

Section 17. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust or in carrying out any directions by the Grantor or the NJDEP issued in accordance with this Agreement. The Trust shall be indemnified and saved harmless by the Grantor or the Trust Fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 18. Choice of Law. This Agreement shall be administered, construed and enforced according to the laws of the State of New Jersey.

In Witness Whereof the parties have caused this Agreement to be executed by their respective officers, duly authorized, and their corporate seals to be hereunto affixed and attested, as of the date first above written:

______________________________ (Signature of Grantor/Title)

ATTEST:

____
[Title/Seal]

______________________________ (Signature of Trustee)

ATTEST:

____
[Title/Seal]

SCHEDULE B

Instructions to the Grantor:

Include here the initial amount of money the Administrative Consent Order requires you to deposit in the irrevocable standy trust fund.

$ __________ in cash

CERTIFICATION OF ACKNOWLEDGEMENT

State of

County of

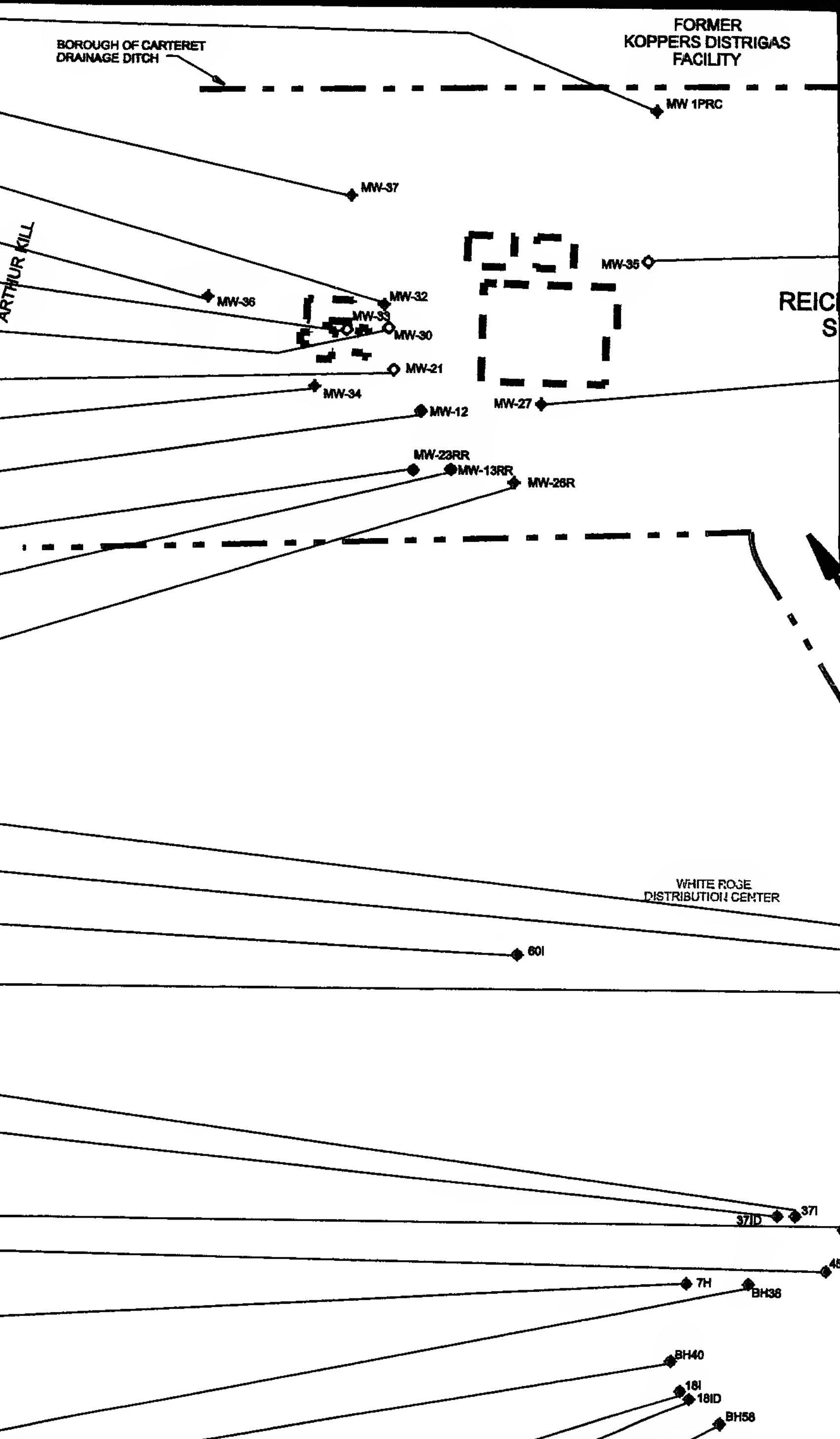
On this _____ day of __________, 19__, before me personally came ____(name)____ to me known, who being by me duly sworn, did depose and say that she/he resides at ______________________________, that she/he is ____(title)____ of AMAX, the corporation described in and which executed the above instrument; that she/he knows the seal of said corporation; that the seal affixed to such instruments is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation, and that she/he signed her/his name thereto by like order.

____

(Notary Public)

Appendix F

Offsite Groundwater Plumes



MW-1PRC	GWQS	Jan-05
Trichloroethene	1	4.4

MW-37	GWQS	Apr-01	Jul-06
Trichloroethene	1	6.2	5.5

MW-32	GWQS	Jul-93	Oct-05
Trichloroethene	1	13	0.58

MW-36	GWQS	Jul-98	Apr-03
Trichloroethene	1	0.4	0.3

MW-33	GWQS	Jul-93	Aug-95
Trichloroethene	1	39	48

MW-30	GWQS	Jul-92	Apr-99
Trichloroethene	1	1	0.4

MW-21	GWQS	Jul-95	Jul-99
Trichloroethene	1	ND	ND

MW-34	GWQS	Jul-93	Jul-06
Trichloroethene	1	150	ND

MW-12	GWQS	May-88	Apr-99
Trichloroethene	1	170	ND

MW-23RR	GWQS	Jul-99	Jul-00
Trichloroethene	1	ND	ND

MW-13RR	GWQS	Aug-96	Apr-99
Trichloroethene	1	ND	ND

MW-26R	GWQS	Jul-93	Apr-00
Trichloroethene	1	2	ND

BH55	GWQS	1988-1989
Tetrachloroethene	1	16

56I	GWQS	1988-1989	DEC-88
Tetrachloroethene	1	3.0	3.0

60I	GWQS	1988-1989
Tetrachloroethene	1	1130
Trichloroethene	1	30

22I	GWQS	Dec-86	Mar-87	Sep-87	1988-1989
Tetrachloroethene	1	1840	<10	<10	230

37I	GWQS	1988-1989
Tetrachloroethene	1	2.2

37ID	GWQS	1988-1989	DEC-88
Tetrachloroethene	1	1.3	4.0

BH54	GWQS	1988-1989
Tetrachloroethene	1	1.5

45I	GWQS	Nov-88	1988-1989
Tetrachloroethene	1	194	178
Trichloroethene	1	9	7.6

7H	GWQS	Apr-86	Aug-86	Dec-86	Mar-87	Jun-87	Sep-87	1988-1989
Tetrachloroethene	1	4.37	3.2	4.5	7.4	2.4	3.1	3.8

BH38	GWQS	1988-1989	DEC-88
Tetrachloroethene	1	8.5	17

BH40	GWQS	1988-1989	Dec-88
Tetrachloroethene	1	47	16
Trichloroethene	1	3	8

18I	GWQS	Dec-86	Mar-87	Jun-87	Sep-87	Dec-88	1988-1989
Tetrachloroethene	1	11.8	13	30.1	11	19	15

18ID	GWQS	Dec-86	Mar-87	Jun-87	Sep-87	Dec-88	1988-1989
Tetrachloroethene	1	106	8.9	28	10	18	73
Trichloroethene	1	6.3	ND	ND	ND	ND	2.6

BH58	GWQS	1988-1989	Dec-88
Tetrachloroethene	1	20	41

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Appendix G

USMR Elevated Concentrations of Metals and VOCs Groundwater Data, and USMR Groundwater Pump and Treatment System

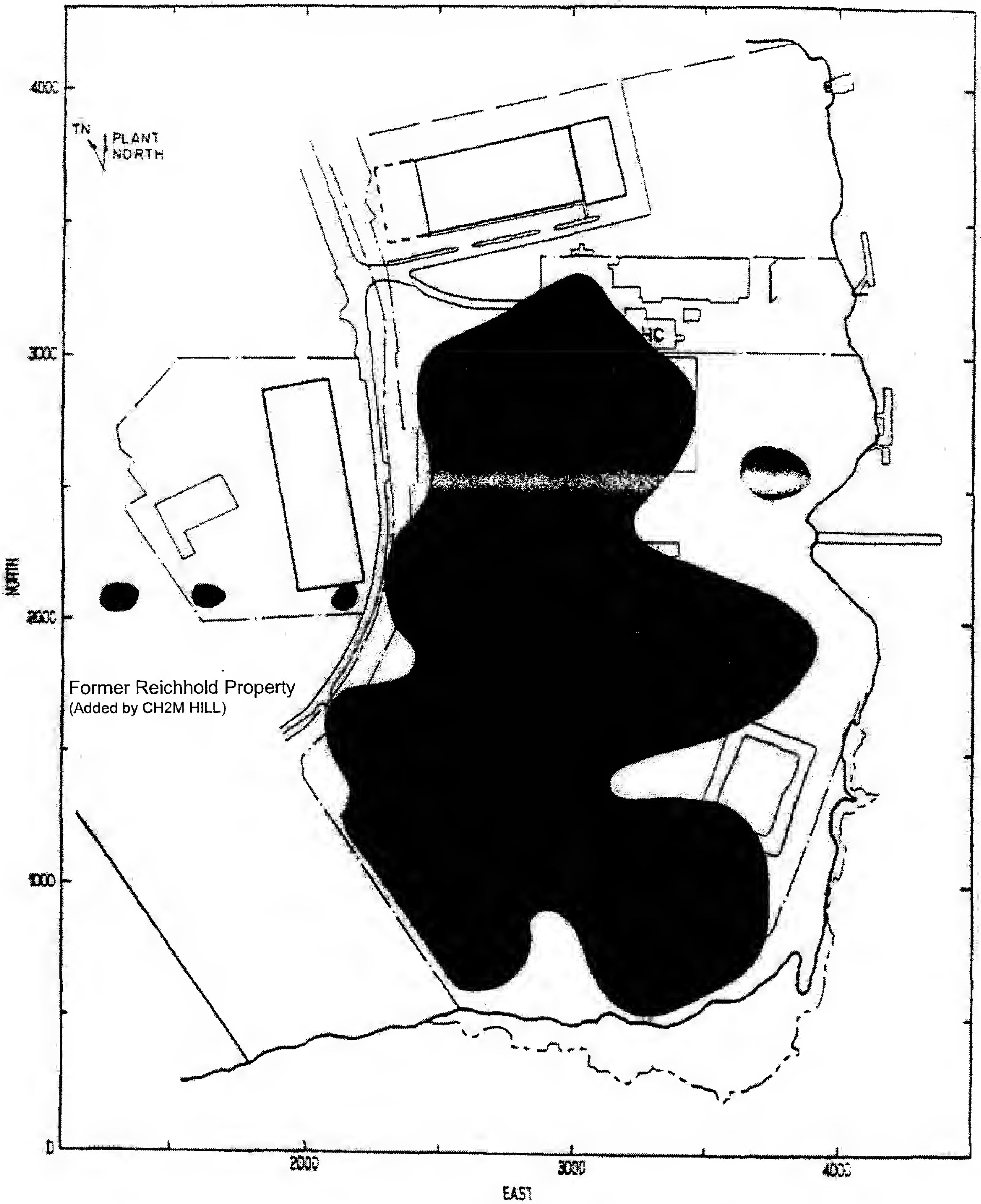


Figure 1-9
Groundwater Areas of Elevated Metals Concentration
(>5 mg/L)

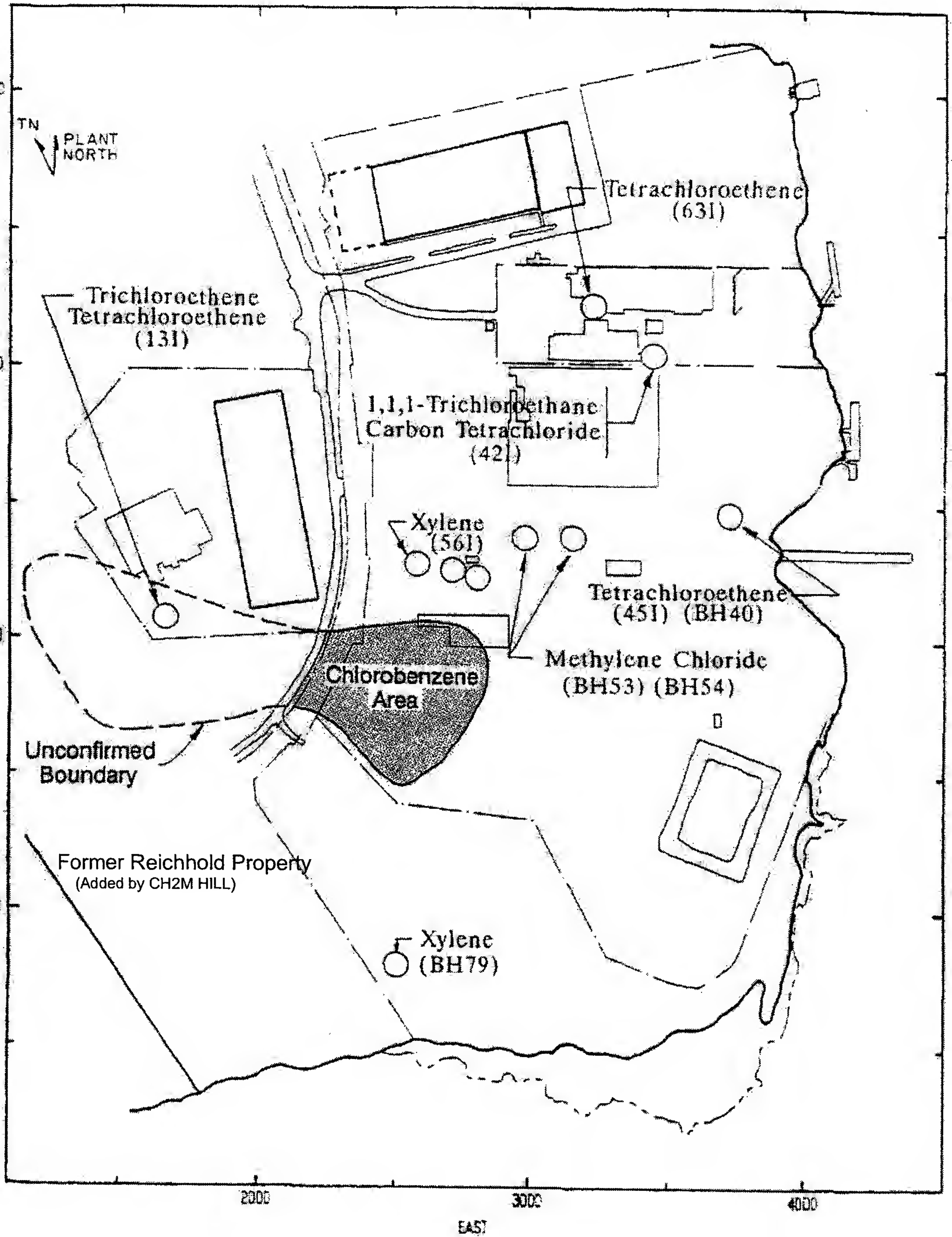


Figure 1-10
Areas of Elevated Concentration of Chlorobenzene and Other Volatile Organics in Groundwater

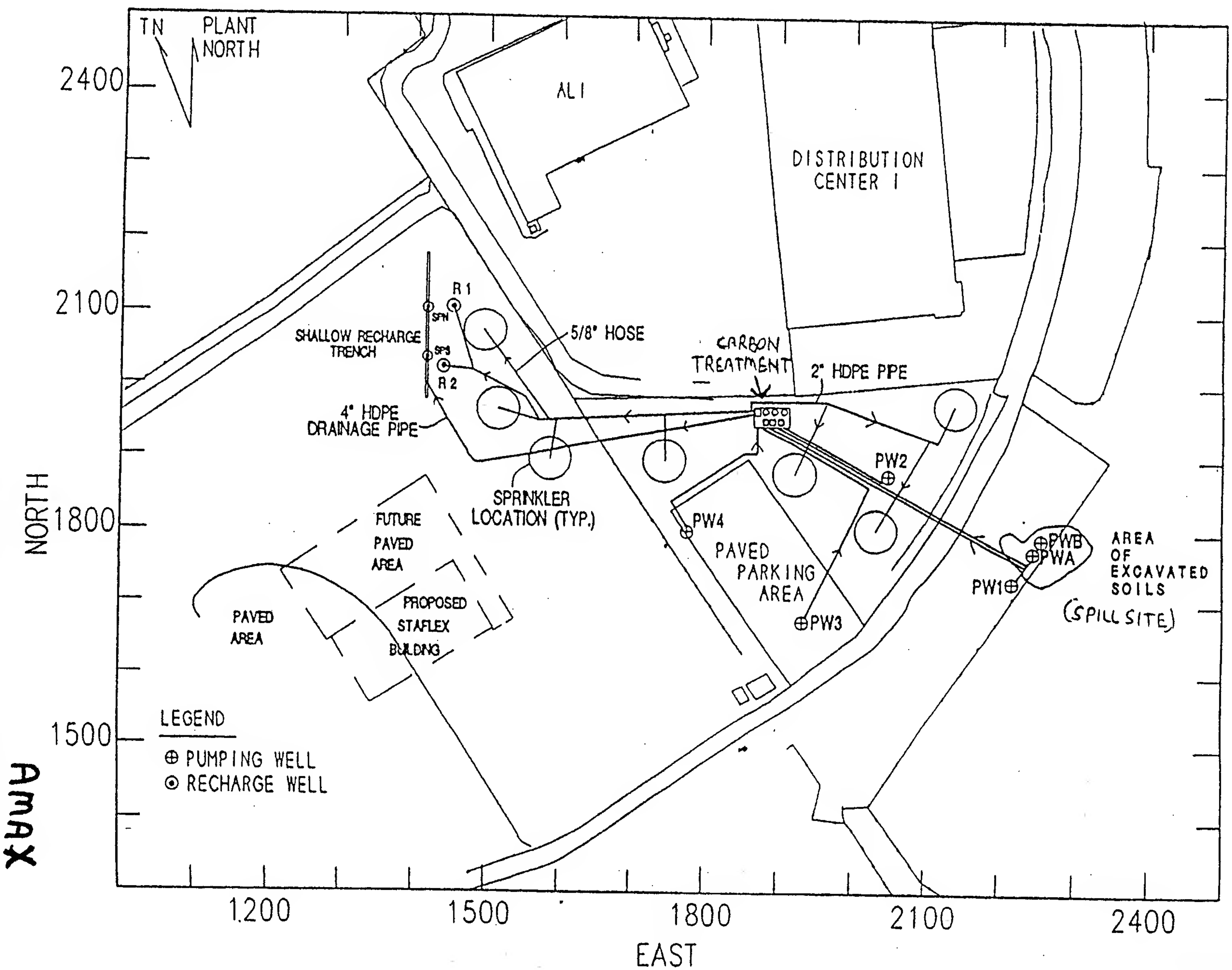
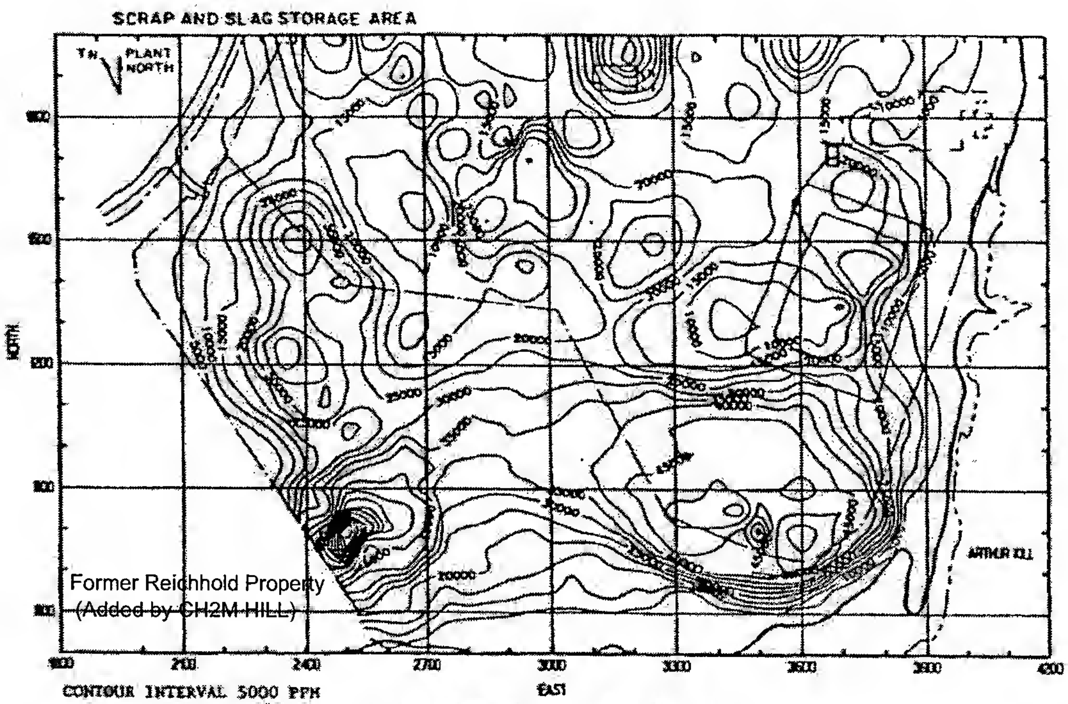


Figure 3. Layout of Pump and Treatment System

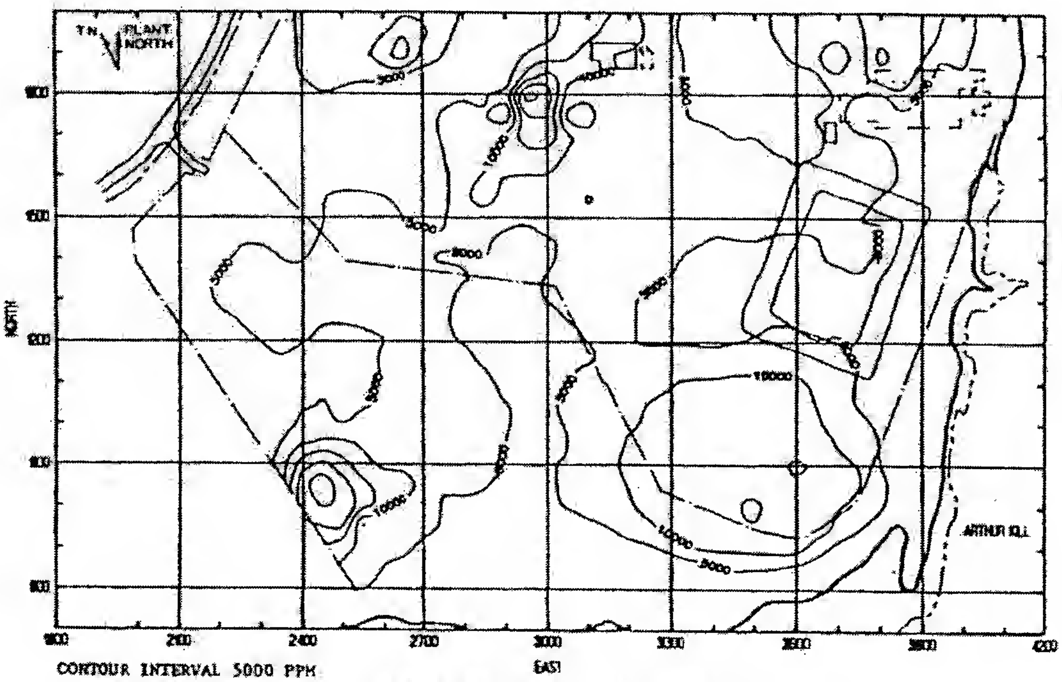
AMAX
FIGURE 3.

Appendix H

USMR Site Soil and Fill Isoconcentration Maps Submitted to NJDEP



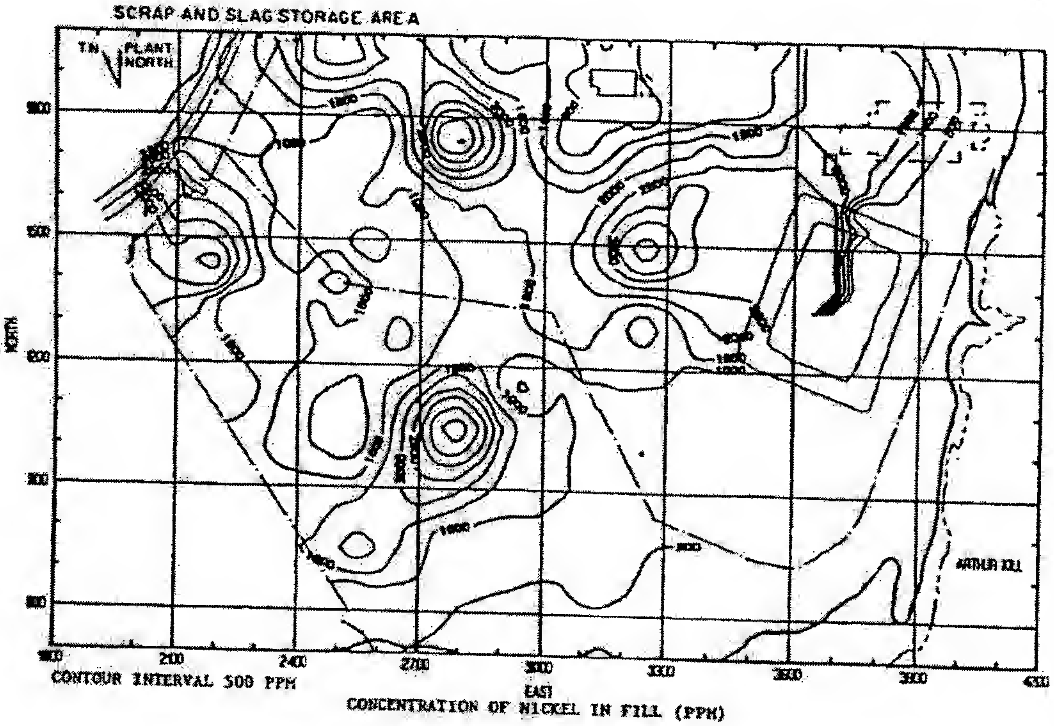
CONCENTRATION OF ZINC IN FILL (PPM)

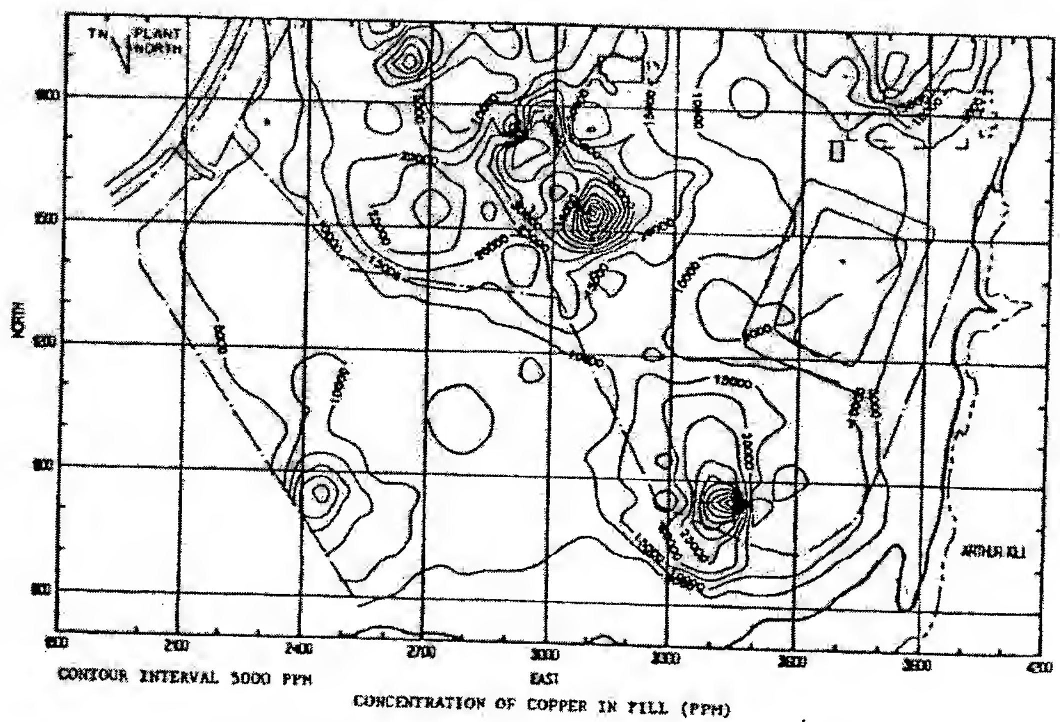


CONCENTRATION OF LEAD IN FILL (PPM)

FIGURES 5D-31 AND 5D-32. CONCENTRATION OF METALS IN FILL
ZINC AND LEAD

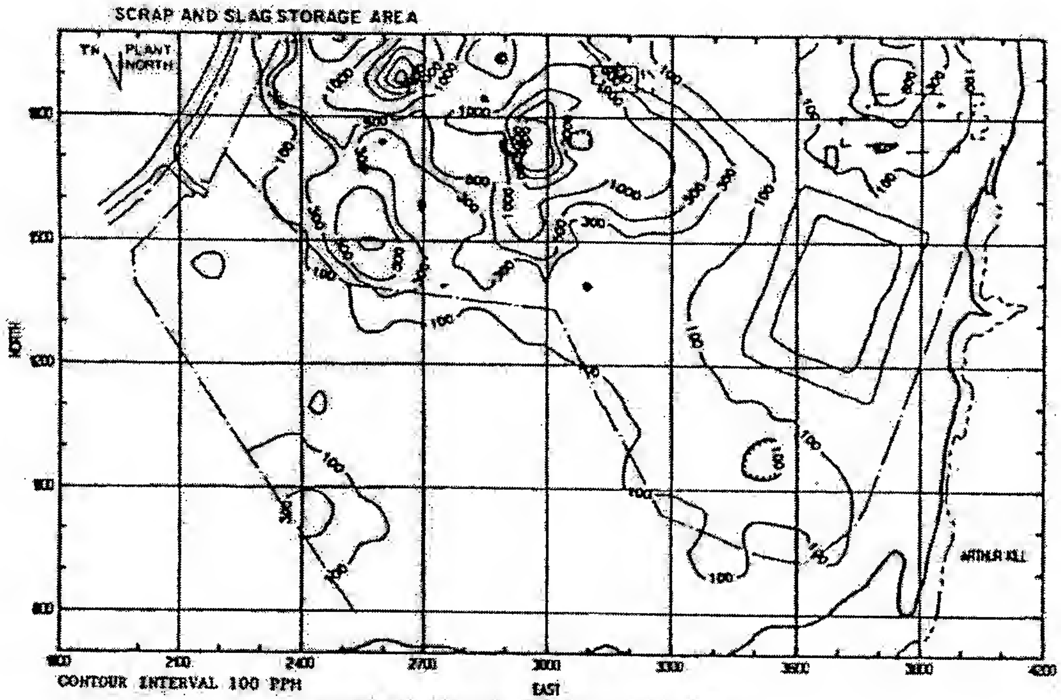
PROPERTY OF AMAX, INC.



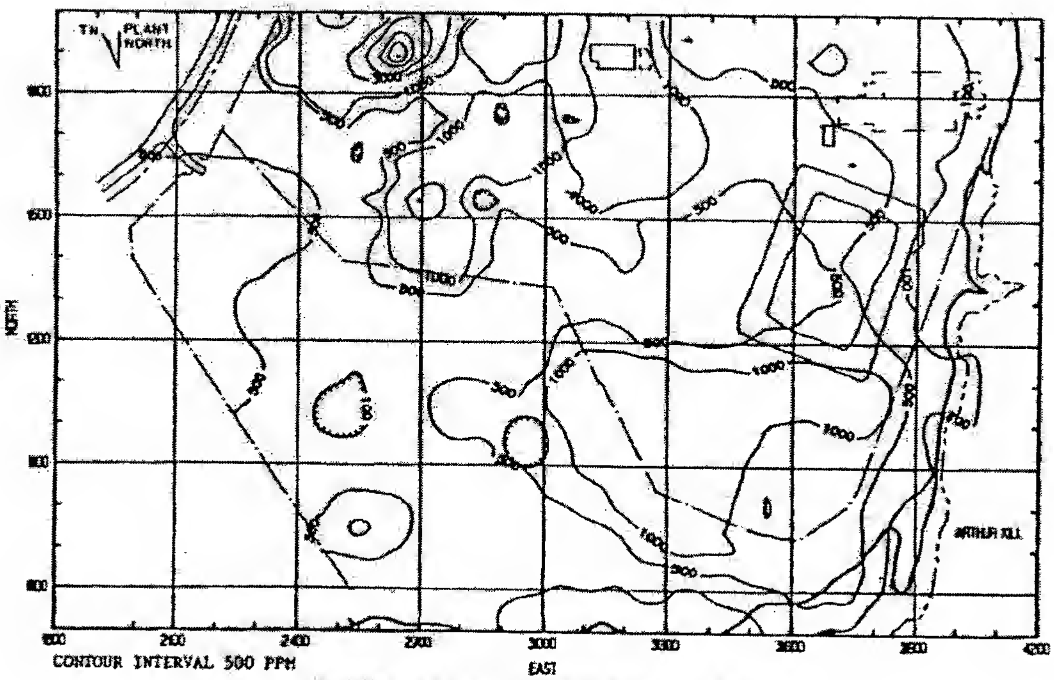


FIGURES 5D-33 AND 5D-34. CONCENTRATION OF METALS IN FILL
NICKEL AND COPPER

PROPERTY OF AMAX, INC.



CONCENTRATION OF CADMIUM IN FILL (PPM)

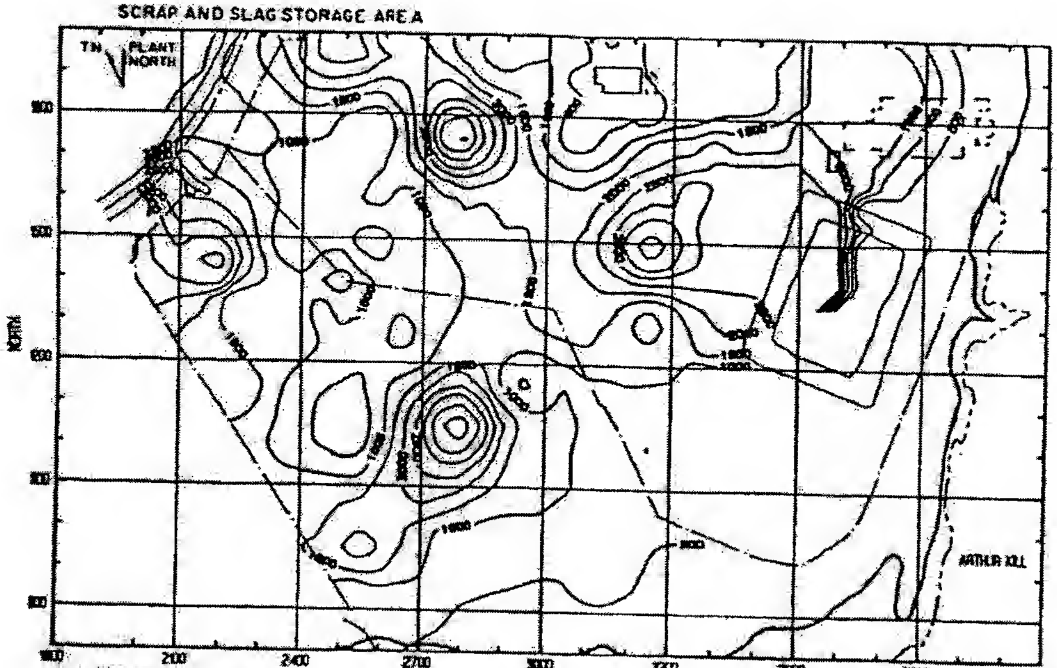


CONCENTRATION OF CHROMIUM IN FILL (PPM)

FIGURE 5D-35 AND 5D-36. CONCENTRATION OF METALS IN FILL
CADMIUM AND CHROMIUM

PROPERTY OF AMAX, INC.

SCRAP AND SLAG STORAGE AREA



CONTOUR INTERVAL 500 PPM

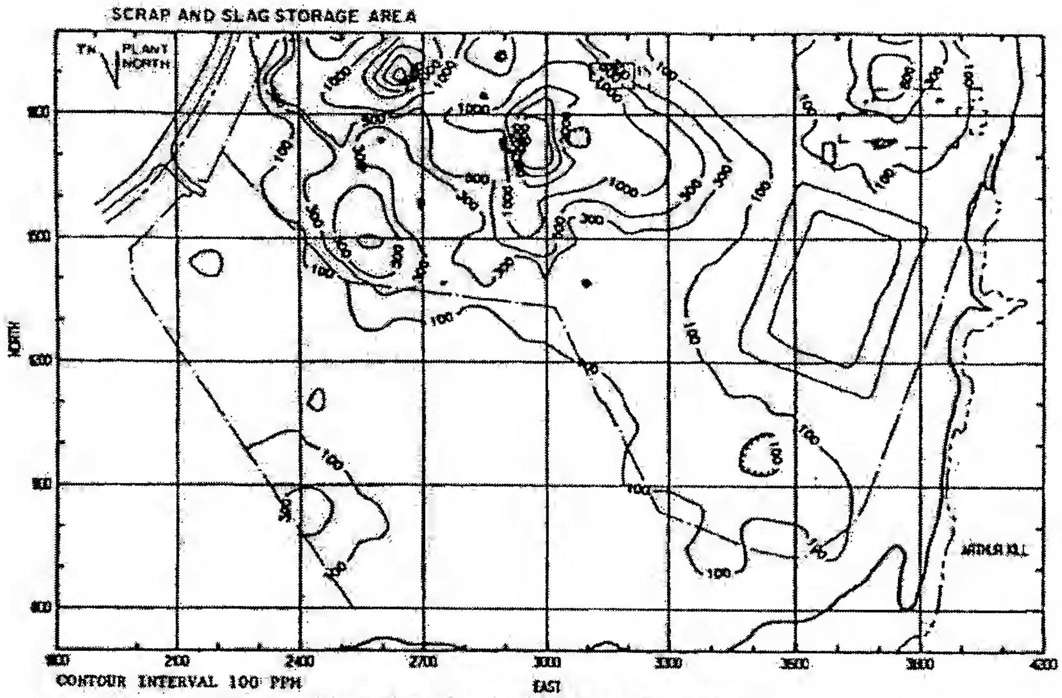
CONCENTRATION OF NICKEL IN FILL (PPM)

CONTOUR INTERVAL 5000 PPM

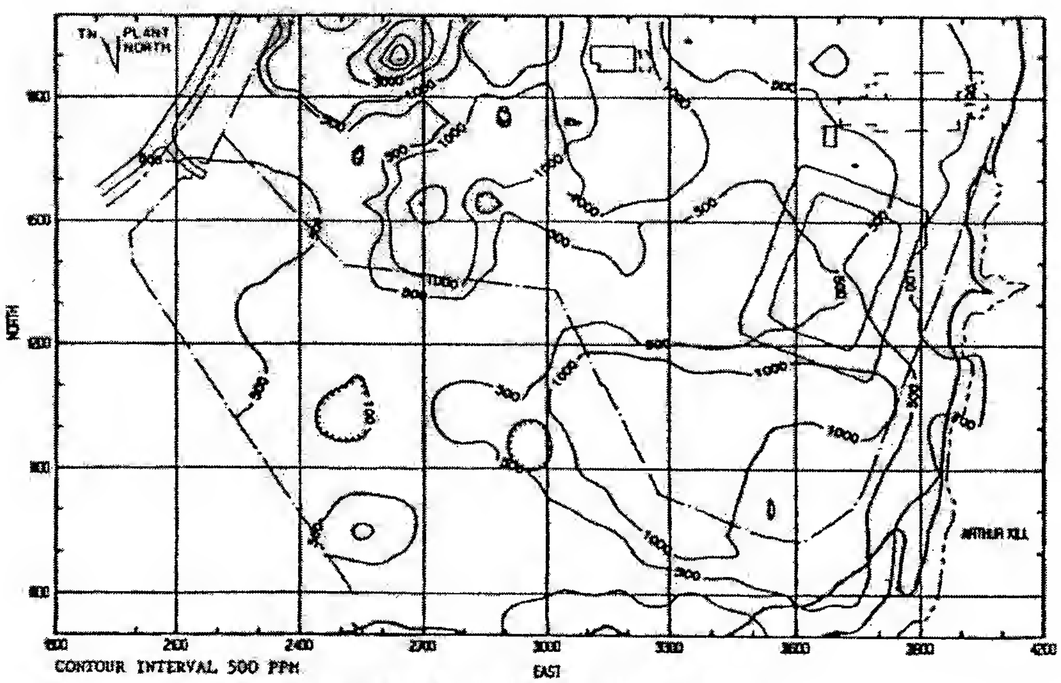
CONCENTRATION OF COPPER IN FILL (PPM)

FIGURES 5D-33 AND 5D-34. CONCENTRATION OF METALS IN FILL
NICKEL AND COPPER

PROPERTY OF AMAX, INC.



CONCENTRATION OF CADMIUM IN FILL (PPM)



CONCENTRATION OF CHROMIUM IN FILL (PPM)

FIGURE 5D-35 AND 5D-36. CONCENTRATION OF METALS IN FILL
CADMIUM AND CHROMIUM

PROPERTY OF AMAX, INC.

Appendix I

USMR Outfall Locations

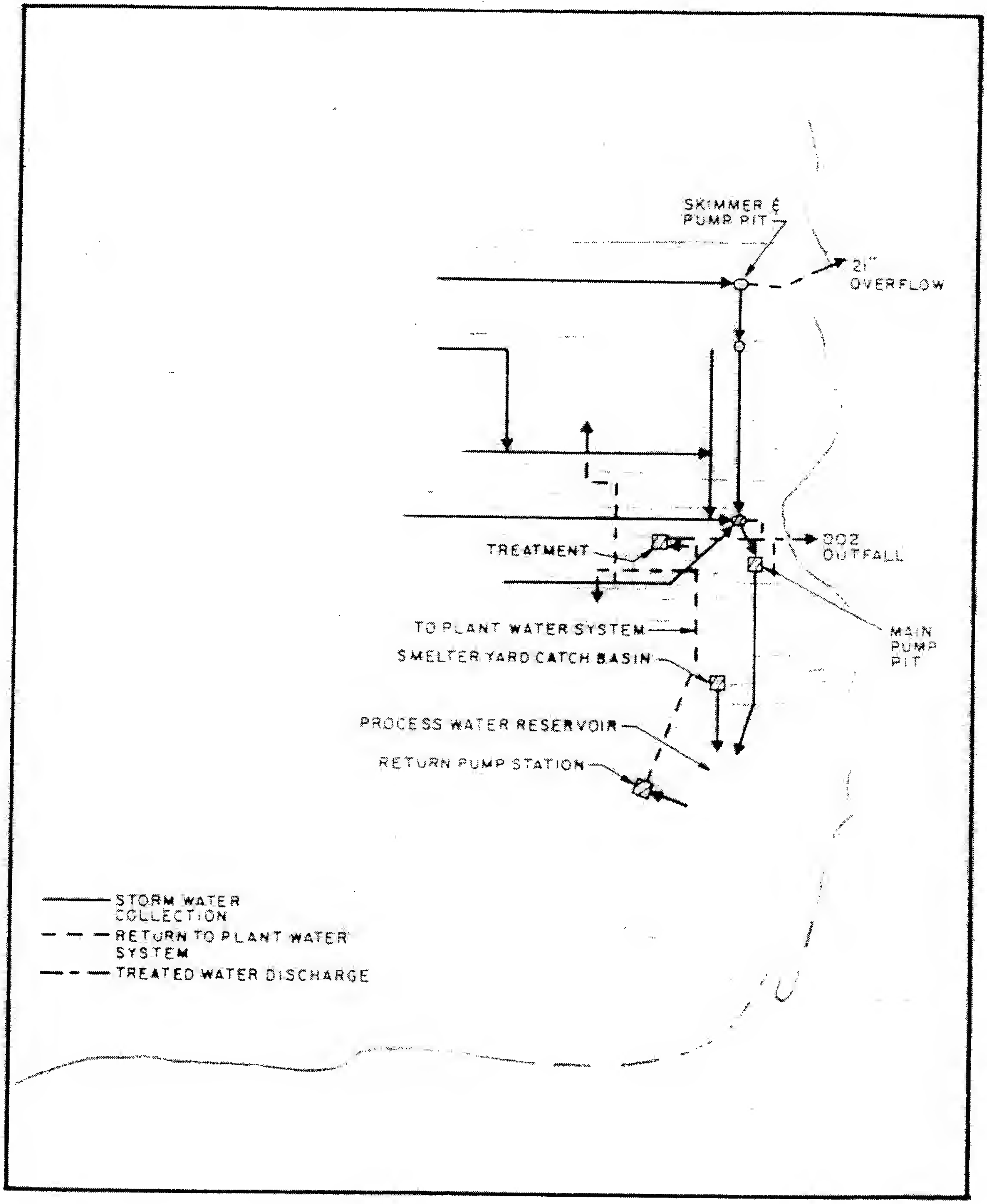


FIGURE 6-1. SCHEMATIC LAYOUT OF PROCESS AND STORM WATER SYSTEM

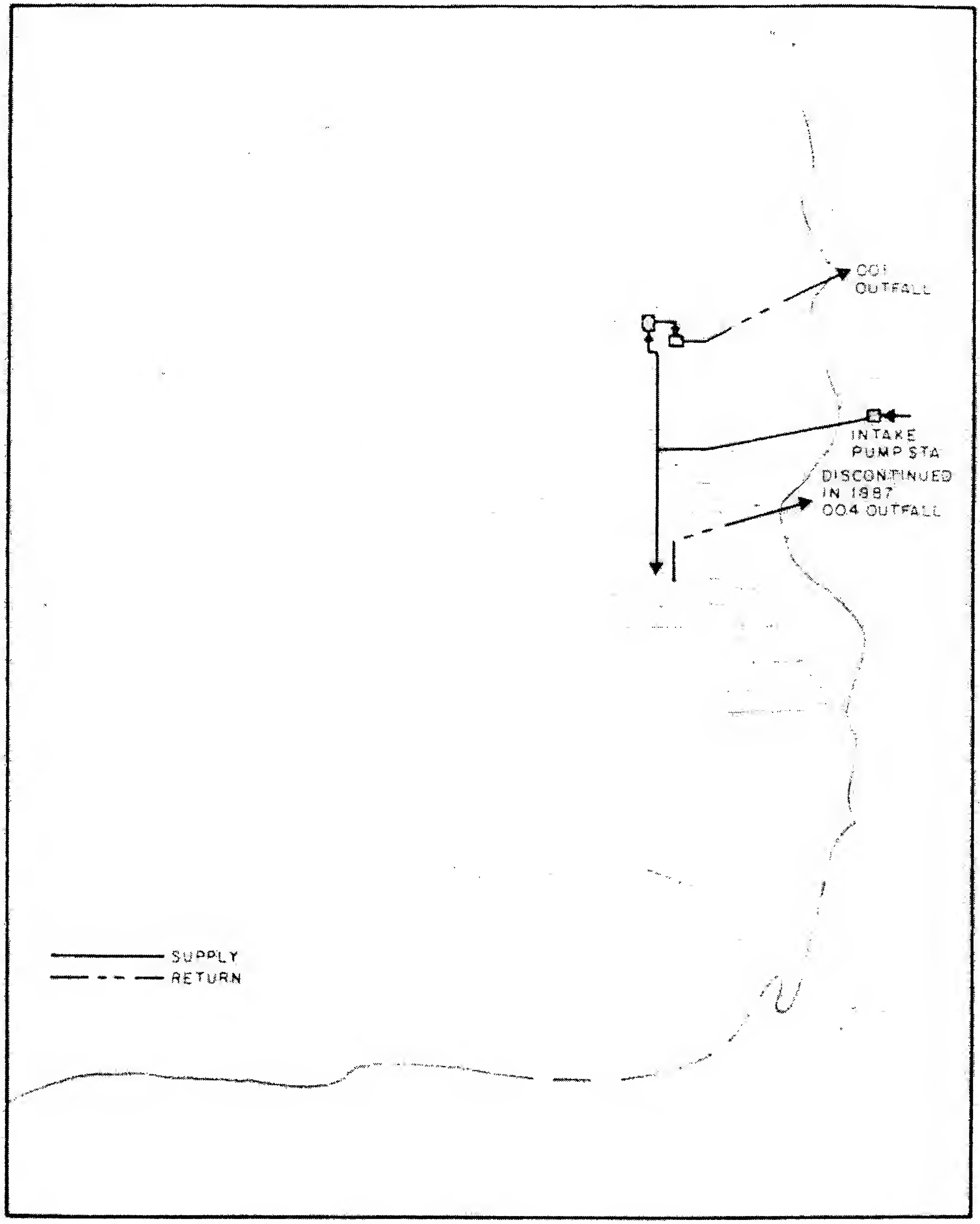


FIGURE 6-3. SCHEMATIC LAYOUT OF SALT WATER SYSTEM

Appendix J

USMR Chronological Listing of NPDES Permit Violations

UNITED STATES METALS REFINING CO.
CHRONOLOGICAL LISTING OF PERMIT VIOLATIONS

	DMR	Outfall/ Parameter	Permit Amount	Limitation	Type	Reported Amount		Magnitude of violation (%)
1.	12/77	001 Cu	8.0	kg/day	A	10.7	kg/day	34
2.	12/77	001 Zn	10.0	kg/day	A	47.7	kg/day	377
3.	1/78	001 Cu	8.0	kg/day	A	9.54	kg/day	19
4.	2/78	001 Cu	8.0	kg/day	A	10.6	kg/day	33
5.	2/78	001 Zn	10.0	kg/day	A	17.8	kg/day	78
6.	5/78	002 O&G	4.3	kg/day	A	20.7	kg/day	381
7.	5/78	002 Cd	0.45	kg/day	A	0.5	kg/day	11
8.	5/78	002 Cu	0.54	kg/day	A	10.6	kg/day	1863
9.	5/78	002 Pb	0.45	kg/day	A	7.3	kg/day	1522
10.	5/78	002 Zn	0.63	kg/day	A	5.8	kg/day	821
11.	6/78	002 TSS	8.7	kg/day	A	47.0	kg/day	440
12.	6/78	002 Zn	0.63	kg/day	A	6.7	kg/day	963
13.	6/78	001 TSS	136.0	kg/day	A	181.2	kg/day	33
14.	7/78	001 Temp	28.7	Deg. C	A	31.7	Deg. C	10
15.	7/78	002 TSS	8.7	kg/day	A	498.3	kg/day	17122
16.	7/78	002 O&G	4.3	kg/day	A	40.57	kg/day	843
17.	7/78	002 Cd	0.45	kg/day	A	0.80	kg/day	78
18.	7/78	002 Cu	0.54	kg/day	A	2.3	kg/day	326
19.	7/78	002 Zn	0.63	kg/day	A	4.52	kg/day	617
20.	7/78	004 Temp	27.0	Deg. C	A	30.0	Deg. C	11
21.	8/78	001 pH	6.0	S.U.	Min.	5.8	S.U.	3
22.	8/78	001 Cu	8.0	kg/day	A	11.35	kg/day	42
23.	8/78	001 Temp	28.7	Deg. C	A	34.0	Deg. C	18
24.	8/78	002 TSS	8.7	kg/day	A	599.4	kg/day	6790
25.	8/78	002 Cu	0.54	kg/day	A	3.6	kg/day	57
26.	8/78	002 Zn	0.63	kg.day	A	6.0	kg/day	852
27.	8/78	002 Temp	31.6	Deg. C	A	32.8	Deg. C	4
28.	8/78	004 Temp	27.0	Deg. C	A	32.8	Deg. C	21
29.	9/78	001 Temp	28.7	Deg. C	A	32.6	Deg. C	14
30.	9/78	002 Pb	0.45	kg/day	A	2.5	kg/day	456
31.	9/78	002 Cd	0.45	kg/day	A	0.5	kg/day	11
32.	9/78	002 Zn	0.63	kg.day	A	3.1	kg/day	392
33.	9/78	004 Temp	27.0	Deg. C	A	29.2	Deg. C	8
34.	10/78	002 TSS	8.7	kg/day	A	282.5	kg/day	3147
35.	10/78	002 Pb	0.45	kg/day	A	6.5	kg/day	1344
36.	10/78	002 Cu	0.54	kg/day	A	16.3	kg/day	2419
37.	10/78	002 Zn	0.63	kg/day	A	9.6	kg/day	1424
38.	11/78	001 TSS	136.0	kg/day	A	217.2	kg/day	60
39.	11/78	001 Temp	21.4	Deg. C	A	24.4	Deg. C	14
40.	11/78	002 TSS	8.7	kg/day	A	70.9	kg/day	715
41.	11/78	002 TSS	17.4	kg/day	M	483.7	kg/day	2680
42.	11/78	002 O&G	6.5	kg/day	M	38.0	kg/day	485
43.	11/78	002 Cu	1.07	kg.day	M	5.9	kg/day	451
44.	11/78	002 Pb	0.45	kg/day	A	1.0	kg/day	122
45.	11/78	002 Pb	0.90	kg/day	M	8.7	kg/day	867
46.	11/78	002 Zn	0.63	kg/day	A	5.3	kg/day	741
47.	11/78	002 Zn	1.26	kg/day	M	143.0	kg/day	11249

APPENDIX B

48.	12/78	002	TSS	8.7	kg/day	A	441.2	kg/day	4971
49.	12/78	002	TSS	17.4	kg/day	M	2181.1	kg/day	12435
50.	12/78	002	O&G	4.3	kg/day	A	18.0	kg/day	319
51.	12/78	002	O&G	6.5	kg/day	M	63.8	kg/day	582
52.	12/78	002	Cu	1.07	kg/day	M	6.0	kg/day	4611
53.	12/78	002	Zn	0.63	kg/day	A	3.0	kg/day	376
54.	12/78	002	Zn	1.26	kg/day	M	20.1	kg/day	1495
55.	1/79	002	TSS	8.7	kg/day	A	163.7	kg/day	1782
56.	1/79	002	TSS	17.4	kg/day	M	1323.9	kg/day	7509
57.	1/79	002	O&G	6.5	kg/day	M	12.5	kg/day	92
58.	1/79	002	N	8.7	kg/day	A	9.0	kg/day	3
59.	1/79	002	N	17.4	kg/day	M	30.2	kg/day	74
60.	1/79	002	Cd	0.9	kg/day	M	1.2	kg/day	33
61.	1/79	002	Cu	1.07	kg/day	M	2.0	kg/day	87
62.	1/79	002	Zn	0.53	kg/day	A	14.4	kg/day	2186
63.	1/79	002	Zn	1.26	kg/day	M	46.5	kg/day	3590
64.	2/79	001	TSS	272.0	kg/day	M	393.Q	kg/day	44
65.	2/79	002	TSS	17.4	kg/day	M	535.1	kg/day	2975
66.	2/79	002	O&G	4.3	kg/day	A	7.3	kg/day	70
67.	2/79	002	O&G	6.5	kg/day	M	35.4	kg/day	445
68.	2/79	002	Cd	0.45	kg/day	A	2.10	kg/day	367
69.	2/79	002	Cd	0.90	kg/day	M	8.19	kg/day	810
70.	2/79	002	Pb	0.45	kg/day	A	0.8	kg/day	78
71.	2/79	002	Pb	0.90	kg/day	M	5.4	kg/day	500
72.	2/79	002	Zn	1.26	kg/day	M	2.9	kg/day	130
73.	3/79	002	TSS	17.4	kg/day	M	409.8	kg/day	2255
74.	3/79	002	O&G	6.5	kg/day	M	78.0	kg.day	1100
75.	3/79	002	Cu	0.54	kg/day	A	2.6	kg/day	3811
76.	3/79	002	Cu	1.07	kg/day	M	12.8	kg/day	1096
77.	3/79	002	Zn	0.63	kg/day	A	6.7	kg/day	963
78.	3/79	002	Zn	1.26	kg/day	M	25.2	kg/day	1900
79.	4/79	002	TSS	8.7	kg/day	A	62.8	kg/day	622
80.	4/79	002	TSS	17.4	kg/day	M	277.5	kg/day	1495
81.	4/79	002	O&G	4.3	kg/day	A	73.7	kg/day	1614
82.	4/79	002	O&G	6.5	kg/day	M	171.8	kg/day	2543
83.	4/79	002	N	8.7	kg/day	A	27.0	kg/day	210
84.	4/79	002	N	17.4	kg/day	M	44.7	kg/day	157
85.	4/79	002	Cd	0.90	kg/day	M	1.11	kg/day	23
86.	4/79	002	Zn	1.26	kg/day	M	10.1	kg/day	702
87.	5/79	002	TSS	17.4	kg/day	M	84.0	kg/day	383
88.	5/79	002	O&G	6.5	kg/day	M	14.6	kg/day	125
89.	5/79	002	Cu	0.54	kg/day	A	0.7	kg/day	30
90.	5/79	002	Cu	1.07	kg/day	M	3.4	kg/day	218
91.	5/79	002	Pb	0.45	kg/day	A	0.7	kg/day	56
92.	5/79	002	Pb	0.90	kg/day	M	3.4	kg/day	278
93.	5/79	002	Zn	1.26	kg/day	M	8.06	kg/day	540
94.	6/79	002	TSS	8.7	kg/day	A	40.3	kg/day	363
95.	6/79	002	TSS	17.4	kg/day	M	862.7	kg/day	4858
96.	6/79	002	O&G	4.3	kg/day	A	23.3	kg/day	442
97.	6/79	002	O&G	6.5	kg/day	M	49.6	kg/day	663
99.	6/79	001	Temp	28.7	Deg. C	A	30.2	Deg. C	5
99.	7/79	002	Zn	0.63	kg/day	A	0.64	kg/day	2
100.	7/79	002	Zn	1.26	kg/day	M	2.43	kg/day	93
101.	7/79	002	TSS	17.4	kg/day	M	442.9	kg/day	2445

102.	7/79	002	O&G	4.3	kg/day	A	12.02	kg/day	180
103.	7/79	002	O&G	6.5	kg/day	M	55.89	kg/day	760
104.	7/79	002	Cd	0.9	kg/day	M	1.49	kg/day	166
105.	7/79	001	Temp	28.7	Deg. C	A	34.2	Deg. C	19
106.	7/79	002	Pb	0.45	kg/day	A	0.5	kg/day	.11
107.	7/79	002	PB	0.9	kg/day	M	2.1	kg.day	133
108.	8/79	001	Temp	28.7	Deg. C	A	34.1	Deg. C	19
109.	8/79	002	Zn	1.26	kg/day	M	2.61	kg/day	107
110.	8/79	002	TSS	8.7	kg/day	A	94.8	kg/day	990
111.	8/79	002	TSS	17.4	kg/day	M	224.1	kg/day	1188
112.	8/79	002	O&G	4.3	kg/day	A	5.6	kg/day	30
113.	8/79	002	O&G	6.5	kg/day	M	27.8	kg/day	328
114.	8/79	002	Cu	1.07	kg/day	M	2.0	kg/day	87
115.	8/79	002	Pb	0.9	kg/day	M	1.6	kg/day	78
116.	9/79	001	Temp	28.7	Deg. C	A	36.1	Deg. C	26
117.	9/79	002	O&G	4.3	kg/day	A	13.9	kg/day	223
118.	9/79	002	O&G	6.5	kg/day	M	61.8	kg/day	851
119.	9/79	002	TSS	17.4	kg/day	M	45.1	kg/day	159
120.	9/79	002	Zn	0.63	kg/day	A	1.98	kg/day	214
121.	9/79	002	Zn	1.26	kg/day	M	4.58	kg/day	263
122.	9/79	004	Temp	27.0	Deg. C	A	29.2	Deg. C	8
123.	10/79	002	TSS	8.7	kg/day	A	263.0	kg/day	2923
124.	10/79	002	TSS	17.4	kg/day	M	752.2	kg/day	4223
125.	10/79	002	O&G	4.3	kg/day	A	6.5	kg/day	51
126.	10/79	002	O&G	6.5	kg/day	M	9.4	kg/day	45
127.	10/79	002	Cd	0.45	kg/day	A	0.49	kg/day	9
128.	10/79	002	Zn	0.63	kg/day	A	5.65	kg/day	797
129.	10/79	002	Zn	1.26	kg/day	M	11.53	kg/day	815
130.	11/79	002	Zn	0.63	kg/day	A	2.80	kg/day	344
131.	11/79	002	Zn	1.26	kg/day	M	8.39	kg/day	5659
132.	11/79	002	TSS	8.7	kg/day	A	224.7	kg/day	2483
133.	11/79	002	TSS	17.4	kg/day	M	694.3	kg/day	3890
134.	11/79	002	O&G	6.5	kg/day	M	10.22	kg/day	57
135.	11/79	002	N	17.4	kg/day	M	24.98	kg/day	44
136.	11/79	002	Pb	0.45	kg/day	A	1.56	kg/day	247
137.	11/79	002	Pb	0.90	kg/day	M	6.25	kg/day	594
138.	11/79	001	Temp	21.4	Deg. C	A	24.8	Deg. C	16
139.	12/79	001	TSS	136.0	kg/day	A	201.7	kg/day	48
140.	12/79	001	TSS	272.0	kg/day	M	507.6	kg/day	87
141.	12/79	002	O&G	4.3	kg/day	A	6.09	kg/day	42
142.	12/79	002	O&G	6.5	kg/day	M	10.75	kg/day	65
143.	12/79	002	Zn	0.63	kg/day	A	3.49	kg/day	454
144.	12/79	002	Zn	1.26	kg/day	M	9.38	kg/day	644
145.	1/80	001	Zn	10.0	kg/day	A	10.69	kg/day	7
146.	1/80	001	Zn	20.0	kg/day	M	21.2	kg/day	6
147.	1/80	002	Cd	0.45	kg/day	A	0.93	kg/day	107
148.	1/80	002	Cd	0.90	kg/day	M	2.92	kg/day	224
149.	1/80	002	Cu	0.54	kg/day	A	0.96	kg/day	78
150.	1/80	002	Cu	1.07	kg/day	M	2.67	kg/day	150
151.	1/80	002	Zn	0.63	kg/day	A	17.6	kg/day	2694
152.	1/80	002	Zn	1.26	kg/day	M	37.09	kg/day	2844
153.	2/80	001	TSS	272.0	kg/day	M	475.6	kg/day	75
154.	2/80	002	Cd	0.45	kg/day	A	5.83	kg/day	1196
155.	2/80	002	Cd	0.90	kg/day	M	9.36	kg/day	940
156.	2/80	002	Cu	0.54	kg/day	A	2.33	kg/day	331

157.	2/80	002	Cu	1.07	kg/day	M	6.93	kg/day	548
158.	2/80	002	Pb	0.45	kg/day	A	3.18	kg/day	607
159.	2/80	002	Pb	0.90	kg/day	M	11.52	kg/day	1180
160.	2/80	002	Zn	0.63	kg/day	A	51.28	kg/day	8040
161.	2/80	002	Zn	1.26	kg/day	M	106.52	kg/day	8354
162.	3/80	002	N	8.7	kg/day	A	12.01	kg/day	38
163.	3/80	002	N	17.4	kg/day	M	20.32	kg/day	17
164.	3/80	002	Cd	0.45	kg/day	A	2.13	kg/day	373
165.	3/80	002	Cd	0.90	kg/day	M	4.76	kg/day	429
166.	3/80	002	Cu	0.54	kg/day	A	1.36	kg/day	152
167.	3/80	002	Cu	1.07	kg/day	M	3.27	kg/day	206
168.	3/80	002	Pb	0.45	kg/day	A	0.47	kg/day	4
169.	3/80	002	Pb	0.90	kg/day	M	1.36	kg/day	51
170.	3/80	002	Zn	0.63	kg/day	A	7.27	kg/day	1054
171.	3/80	002	Zn	1.26	kg/day	M	20.81	kg/day	1552
172.	4/80	001	Zn	20.0	kg/day	M	32.62	kg/day	63
173.	4/80	002	Zn	0.63	kg/day	A	0.77	kg/day	22
174.	4/80	002	Zn	1.26	kg/day	M	1.64	kg/day	30
175.	5/80	002	Cd	0.45	kg/day	A	1.02	kg/day	127
176.	5/80	002	Cd	0.90	kg/day	M	2.13	kg/day	137
177.	5/80	002	Cu	0.54	kg/day	A	6.49	kg/day	1102
178.	5/80	002	Cu	1.07	kg/day	M	17.86	kg/day	1569
179.	5/80	002	Pb	0.45	kg/day	A	3.26	kg/day	624
180.	5/80	002	Pb	0.90	kg/day	M	9.93	kg/day	1003
181.	5/80	002	Zn	0.63	kg/day	A	17.18	kg/day	2627
182.	6/80	001	Zn	10.0	kg/day	A	17.29	kg/day	73
183.	6/80	001	Zn	20.0	kg.day	M	73.83	kg/day	269
184.	5/80	002	Zn	1.26	kg/day	M	36.59	kg/day	2804
185.	6/80	001	Temp	28.7	Deg. C	A	32.0	Deg. C	11
186.	6/80	002	Cu	0.54	kg/day	A	0.79	kg/day	46
187.	6/80	002	Cu	1.07	kg/day	M	1.55	kg/day	45
188.	6/80	002	Zn	0.63	kg/day	A	1.51	kg/day	140
189.	6/80	002	Zn	1.26	kg/day	M	2.96	kg/day	135
190.	7/80	002	O&G	6.5	kg/day	M	8.23	kg/day	27
191.	7/80	002	Cu	0.54	kg/day	A	0.85	kg/day	57
192.	7/80	002	Cu	1.07	kg/day	M	2.24	kg/day	109
193.	7/80	002	Zn	0.63	kg/day	A	1.12	kg/day	78
194.	7/80	002	Zn	1.26	kg/day	M	3.19	kg/day	153
195.	7/80	004	Temp	27.0	Deg. C	A	30.5	Deg. C	13
196.	8/80	002	pH	6.0	S.U.	Min	4.0	S.U.	33
197.	8/80	002	Cd	0.90	kg/day	M	2.12	kg/day	136
198.	8/80	002	Cu	1.07	kg/day	M	14.34	kg/day	1240
199.	8/80	002	Zn	1.26	kg/day	M	7.33	kg/day	482
200.	8/80	004	pH	6.5	S.U.	Min	5.0	S.U.	23
201.	8/80	004	Temp	27.0	Deg. C	A	28.9	Deg. C	7
202.	9/80	002	O&G	6.5	kg/day	M	7.67	kg/day	18
203.	10/80	002	pH	9.0	S.U.	M	9.4	S.U.	4
204.	11/80	001	Temp	21.4	Deg. C	A	23.0	Deg. C	7
205.	12/80	002	pH	9.0	S.U.	M	10	S.U.	11
206.	12/80	002	Zn	0.63	kg/day	A	1.91	kg/day	203
207.	12/80	002	Zn	1.26	kg/day	M	9.5	kg/day	654
208.	1/81	002	Cd	0.90	kg/day	M	1.10	kg/day	22
209.	1/81	002	Pb	0.90	kg/day	M	1.04	kg/day	16
210.	1/81	002	Cu	0.54	kg/day	A	1.63	kg/day	202
211.	1/81	002	Cu	1.07	kg/day	M	6.0	kg/day	461

216.	7/82	004	Temp	27.0	Deg. C	A	29.19	Deg. C
217.	8/82	001	Temp	28.7	Deg. C	A	32.36	Deg. C
218.	8/82	004	Temp	27.0	Deg. C	A	28.43	Deg. C
219.	1/83	002	Cd	0.45	kg/day	A	4.3	kg/day
220.	1/83	002	Cd	0.90	kg/day	M	15.56	kg/day
221.	1/83	002	Cu	0.5	kg/day	A	3.3	kg/day
222.	1/83	002	Cu	1.0	kg/day	M	11.9	kg/day
223.	1/83	002	Zn	0.6	kg/day	A	32.8	kg/day
224.	1/83	002	Zn	1.2	kg/day	M	119.3	kg/day
225.	2/83	001	Zn	20.0	kg/day	M	26.29	kg/day
226.	2/83	002	Cd	0.45	kg/day	A	9.0	kg/day
227.	2/83	002	Cd	0.90	kg/day	M	20.25	kg/day
228.	2/83	002	Cu	0.5	kg/day	A	3.9	kg/day
229.	2/83	002	Cu	1.0	kg/day	M	8.8	kg/day
230.	2/83	002	Zn	0.6	kg/day	A	60.45	kg/day
231.	2/83	002	Zn	1.2	kg/day	M	136.0	kg/day
232.	3/83	002	Cd	0.9	kg/day	M	4.5	kg/day
233.	3/83	002	Cu	1.26	kg/day	M	1.43	kg/day
234.	5/83	001	Zn	10.0	kg/day	A	12.88	kg/day
235.	5/83	001	Zn	20.0	kg/day	M	26.74	kg/day
236.	6/83	001	Zn	20.0	kg/day	M	27.49	kg/day
237.	6/83	004	Temp	27.0	Deg. C	A	27.67	Deg. C
238.	7/83	001	Zn	20.0	kg/day	M	34.23	kg/day
239.	7/83	004	Temp	27.0	Deg. C	A	32.04	Deg. C
240.	8/83	002	Cd	0.9	kg/day	M	5.26	kg/day
241.	8/83	002	Cu	1.0	kg/day	M	8.7	kg/day
242.	8/83	002	Pb	0.9	kg/day	M	1.06	kg/day
243.	8/83	002	Zn	1.2	kg/day	M	27.27	kg/day
244.	8/83	004	Temp	27.0	Deg. C	A	32.32	Deg. C
245.	9/83	001	Temp	28.7	Deg. C	A	30.16	Deg. C
246.	9/83	004	Temp	27.0	Deg. C	A	29.79	Deg. C
247.	12/83	002	Cd	0.45	kg/day	A	2.93	kg/day
248.	12/83	002	Cd	0.90	kg/day	M	12.8	kg/day
249.	12/83	002	Zn	0.63	kg/day	A	3.27	kg/day
250.	12/83	002	Zn	1.26	kg/day	M	12.9	kg/day
251.	1/84	002	Cd	0.45	kg/day	A	0.56	kg/day
252.	1/84	002	Cd	0.90	kg/day	M	1.34	kg/day
253.	1/84	002	Cu	0.54	kg/day	A	0.86	kg/day
254.	1/84	002	Cu	1.07	kg/day	M	2.65	kg/day
255.	1/84	002	Zn	0.63	kg/day	A	3.02	kg/day
256.	1/84	002	Zn	1.26	kg/day	M	9.00	kg/day
257.	2/84	002	Zn	0.63	kg/day	A	0.79	kg/day
258.	2/84	002	Zn	1.26	kg/day	M	2.16	kg/day
259.	2/84	002	Cu	1.07	kg/day	A	1.24	kg/day
260.	3/84	002	Cd	0.90	kg/day	A	2.5	kg/day
261.	3/84	002	Zn	0.63	kg/day	A	1.01	kg/day
262.	3/84	002	Zn	1.26	kg/day	M	12.8	kg/day
263.	4/84	002	Zn	0.63	kg/day	A	0.66	kg/day
264.	4/84	002	Zn	1.26	kg/day	M	10.54	kg/day
265.	4/84	002	Cu	1.07	kg/day	M	1.17	kg/day
266.	4/84	002	Cd	0.90	kg/day	M	1.83	kg/day
267.	4/84	001	Cu	8.0	kg/day	A	14.24	kg/day
268.	4/84	001	Cu	16.0	kg/day	M	46.8	kg/day
269.	7/84	004	Temp	27.0	Deg. C	A	27.5	Deg. C
270.	8/84	004	Temp	27.0	Deg. C	A	32.22	Deg. C

	1/86	002 pH	6.5	S.U.	Min	6.0	S.U.	8
	1/86	002 N	17.4	kg/day	M	22.11	kg/day	27
.	1/86	002 Cd	0.45	kg/day	A	2.03	kg/day	351
.	1/86	002 Cd	0.90	kg/day	M	8.94	kg/day	893
.	1/86	002 Cu	0.54	kg/day	A	1.70	kg/day	215
.	1/86	002 Cu	1.07	kg/day	M	6.77	kg/day	533
3.	1/86	002 Pb	0.90	kg/day	M	0.97	kg/day	8
9.	1/86	002 Zn	0.63	kg/day	A	7.21	kg/day	1044
0.	1/86	002 Zn	1.26	kg/day	M	33.35	kg/day	2547
1.	2/86	002 TSS	8.7	kg/day	A	14.06	kg/day	62
2.	2/86	002 TSS	17.4	kg/day	M	29.4	kg/day	69
3.	2/86	002 N	8.7	kg/day	A	14.21	kg/day	63
34.	2/86	002 N	17.4	kg/day	M	34.5	kg/day	98
35.	2/86	002 Cd	0.45	kg/day	A	22.37	kg/day	4871
36.	2/86	002 Cd	0.90	kg/day	M	45.0	kg/day	4900
37.	2/86	002 Cu	0.54	kg/day	A	17.08	kg/day	3063
38.	2/86	002 Cu	1.07	kg/day	M	39.53	kg/day	3594
39.	2/86	002 Zn	0.63	kg/day	A	74.0	kg/day	11646
340.	2/86	002 Zn	1.26	kg/day	M	138.75	kg/day	10912
341.	2/86	004 Turbidity	25	JTU	A	36.4	JTU	46
342.	3/86	002 TSS	8.7	kg/day	A	19.5	kg/day	124
343.	3/86	002 TSS	17.4	kg/day	M	47.25	kg/day	172
344.	3/86	002 O&G	4.3	kg/day	A	5.0	kg/day	16
345.	3/86	002 N	8.7	kg/day	A	19.4	kg/day	123
346.	3/86	002 N	17.4	kg/day	M	23.18	kg/day	33
347.	3/86	002 Cd	0.45	kg/day	A	3.93	kg/day	773
348.	3/86	002 Cd	0.90	kg/day	M	10.25	kg/day	1039
349.	3/86	002 Cu	0.54	kg/day	A	2.5	kg/day	363
350.	3/86	002 Cu	1.07	kg/day	M	4.75	kg/day	344
351.	3/86	002 Ag	0.45	kg/day	A	0.75	kg/day	66
352.								

List of Abbreviations

A	Average
Ag	Silver
Cd	Cadmium
Cu	Copper
DMR	Discharge Monitoring Report
JTU	Jackson Turbidity Units
M	Maximum
Min	Minimum
N	Nitrogen
O&G	Oil and grease
Pb	Lead
Temp	Temperature
TSS	Total Suspended Solids
Zn	Zinc